



pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION



Bureau of Point and
Non Point Source Management

Susquehanna River Water Quality Monitoring & Assessment 2012-13



The Assessment Problem

- The lower Susquehanna River was a world-class Smallmouth Bass (SMB) fishery
- Wide-scale, disease-related mortality of young-of-year (YOY) SMB was first documented in 2005.
- Poor SMB recruitment
- Lesions, tumors, and other deformities were becoming common.
- Pathology of adult SMB detected a high degree of intersex conditions suggesting endocrine disruption.

Integrated listing Concerns

- Alarmed, local stakeholders called for listing the Lower Susquehanna River mainstem as 303d impaired.
- Listing the Lower Susquehanna as impaired is not currently possible nor defensible:
 - *Long-term ambient water chemistry was compliant,*
 - *Designated uses were being attained.*
- In order to assess Susquehanna River and its SMB fishery in a scientifically defensible manner, PA-DEP launched this very rigorous three year study of the Lower Susquehanna River and its major tributaries.

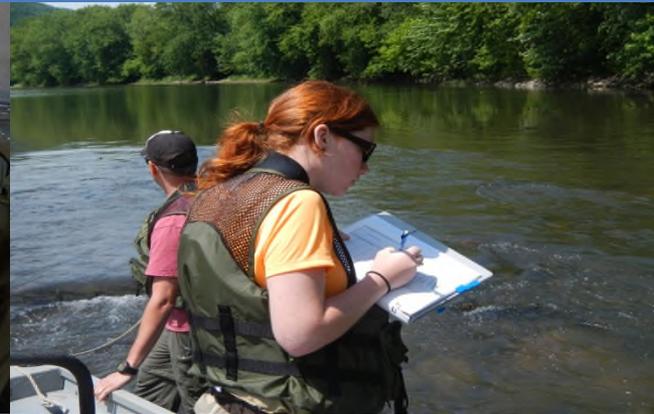
2012-13 Water Quality Monitoring

- Discrete Water Quality Transect Characterization
- Continuous Instream Water Quality Monitoring (data sondes)
- Water Chemistry Grab Sampling
- Periphyton Monitoring (Fixed Transect & Random)
- Benthic Macroinvertebrate Surveys
- Semi-Quantitative Fish Surveys (Fish Health)
- Mussel Surveys
- Passive Sampler Deployment (Androgenicity/Estrogenicity)
- Sediment Contaminant Sampling
- Routine Fish Tissue Sampling



Large River Core Sample Locations

The large river effort includes 9 intensively sampled sites (4 repeats from 2012 plus 5 new sites including 3 additional out-of-basin controls).

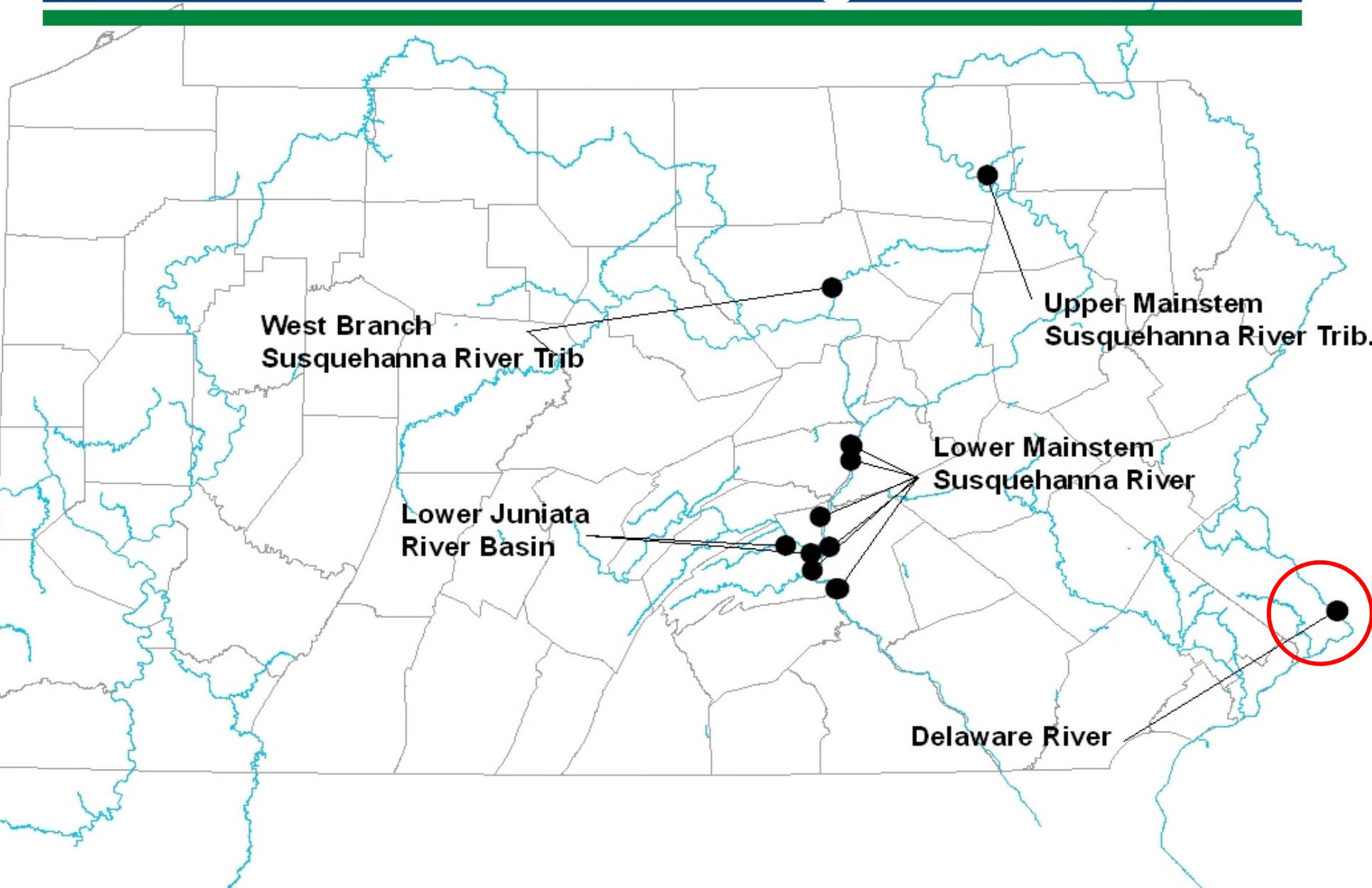




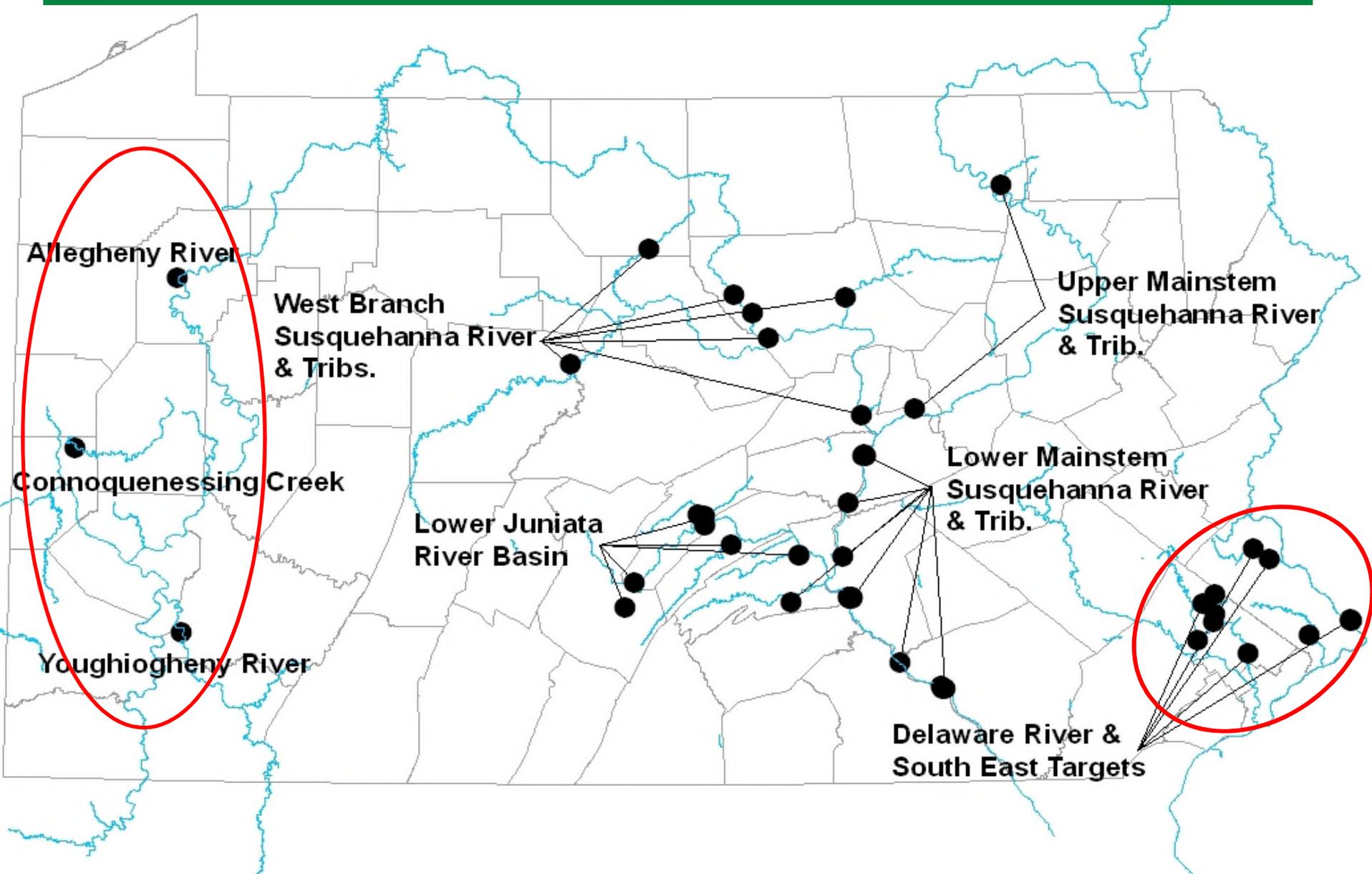
- Susquehanna River at Marietta (New 2013)
- Susquehanna River at Harrisburg
- Susquehanna River at Sunbury
- Juniata River at Newport
- Juniata River at Lewistown Narrows (New 2013)
- Delaware River at Trenton (Out-of-basin control)
- Allegheny River at Franklin (Out-of-basin control, New 2013)
- Youghiogheny River at Sutersville (Out-of-basin control, New 2013)
- Connoquenessing Creek @ Zelenople (Out-of-basin control, New 2013)



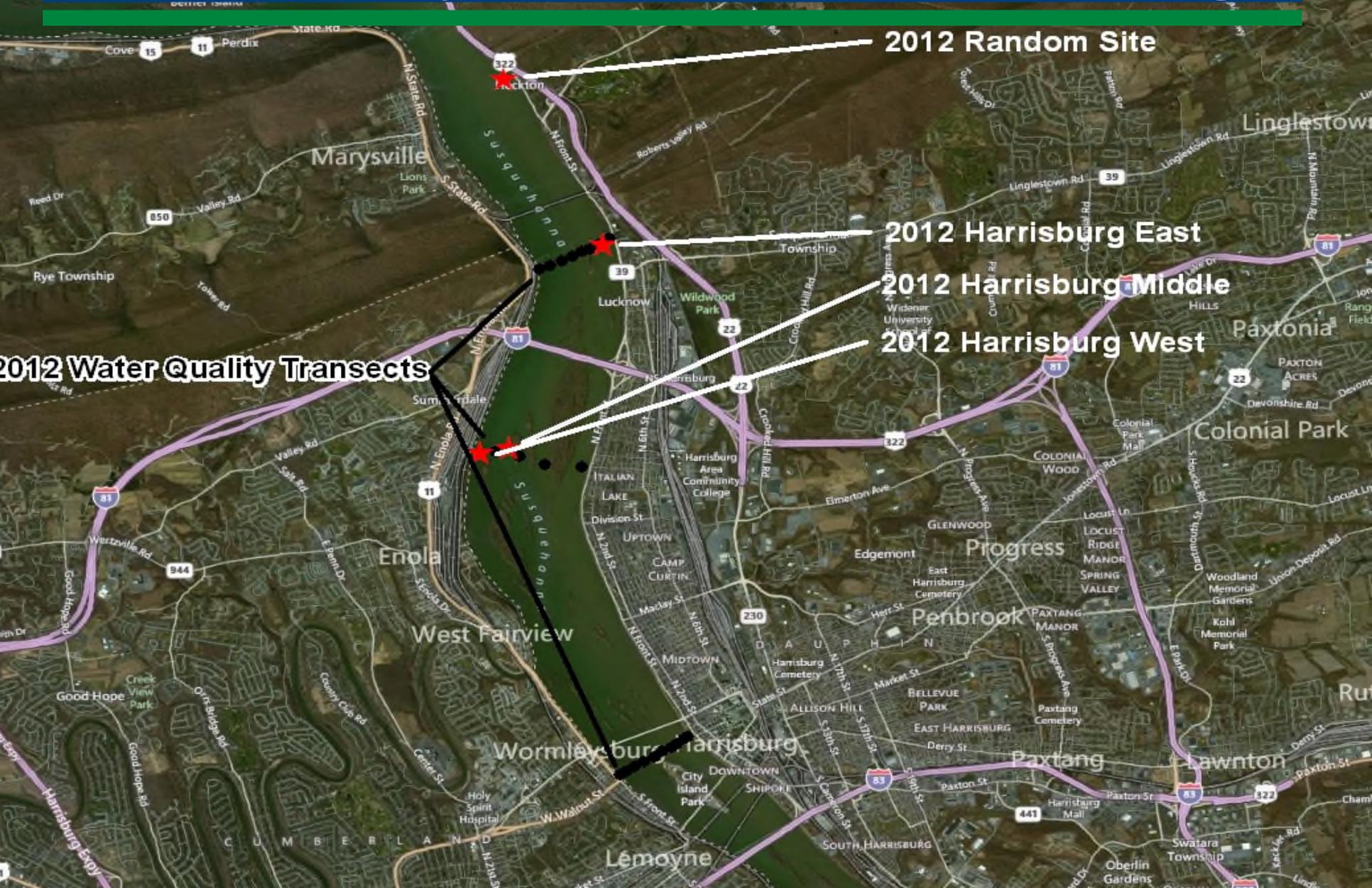
All 2012 Monitoring Locations



All 2013 Monitoring Locations



2012 Susquehanna River @ Harrisburg



2013 Susquehanna River @ Harrisburg

2013 Harrisburg East

2013 Harrisburg Middle

2013 Harrisburg West

2013 Water Quality Transects

2012 Random Site

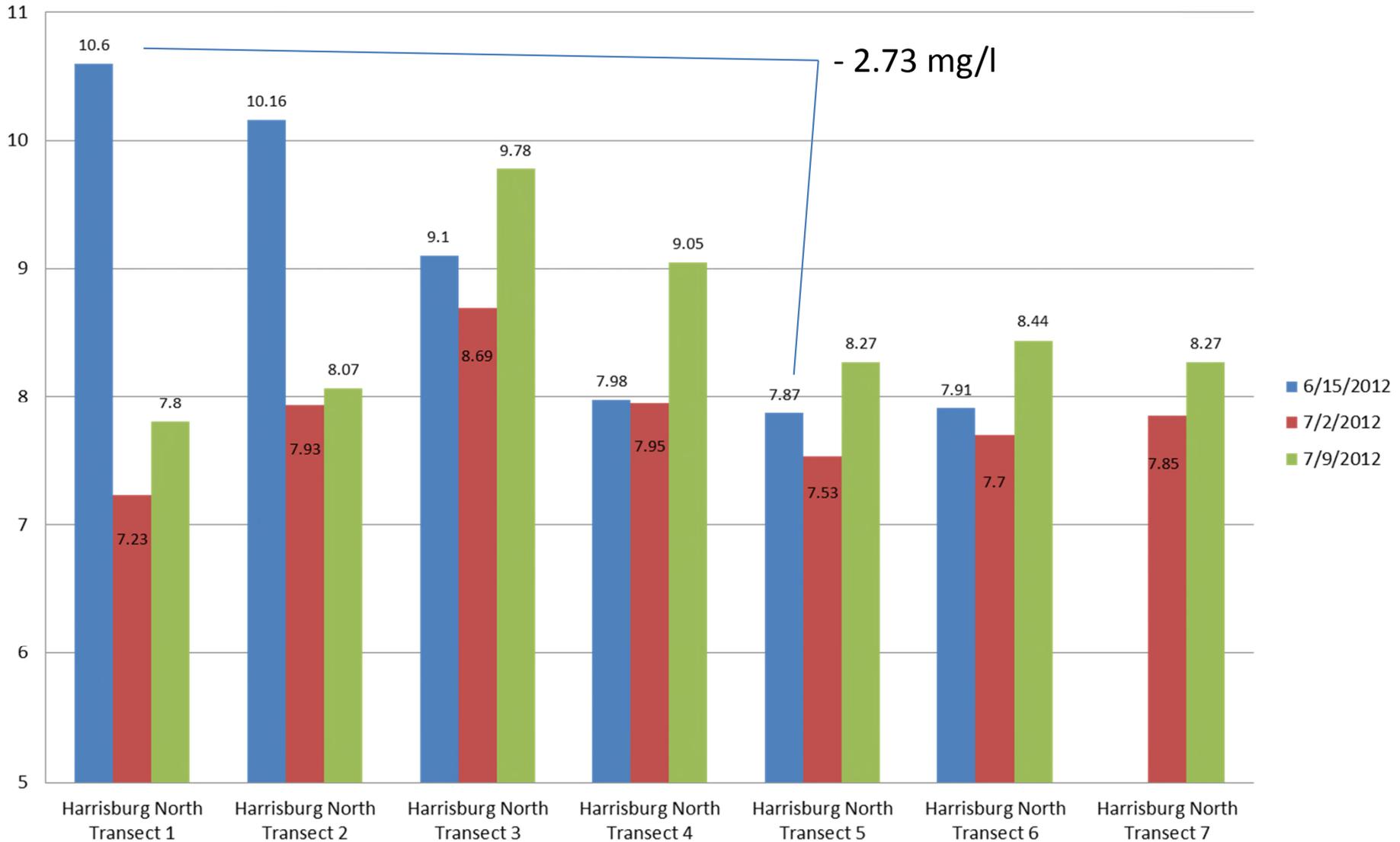
2012 Harrisburg East

2012 Harrisburg Middle

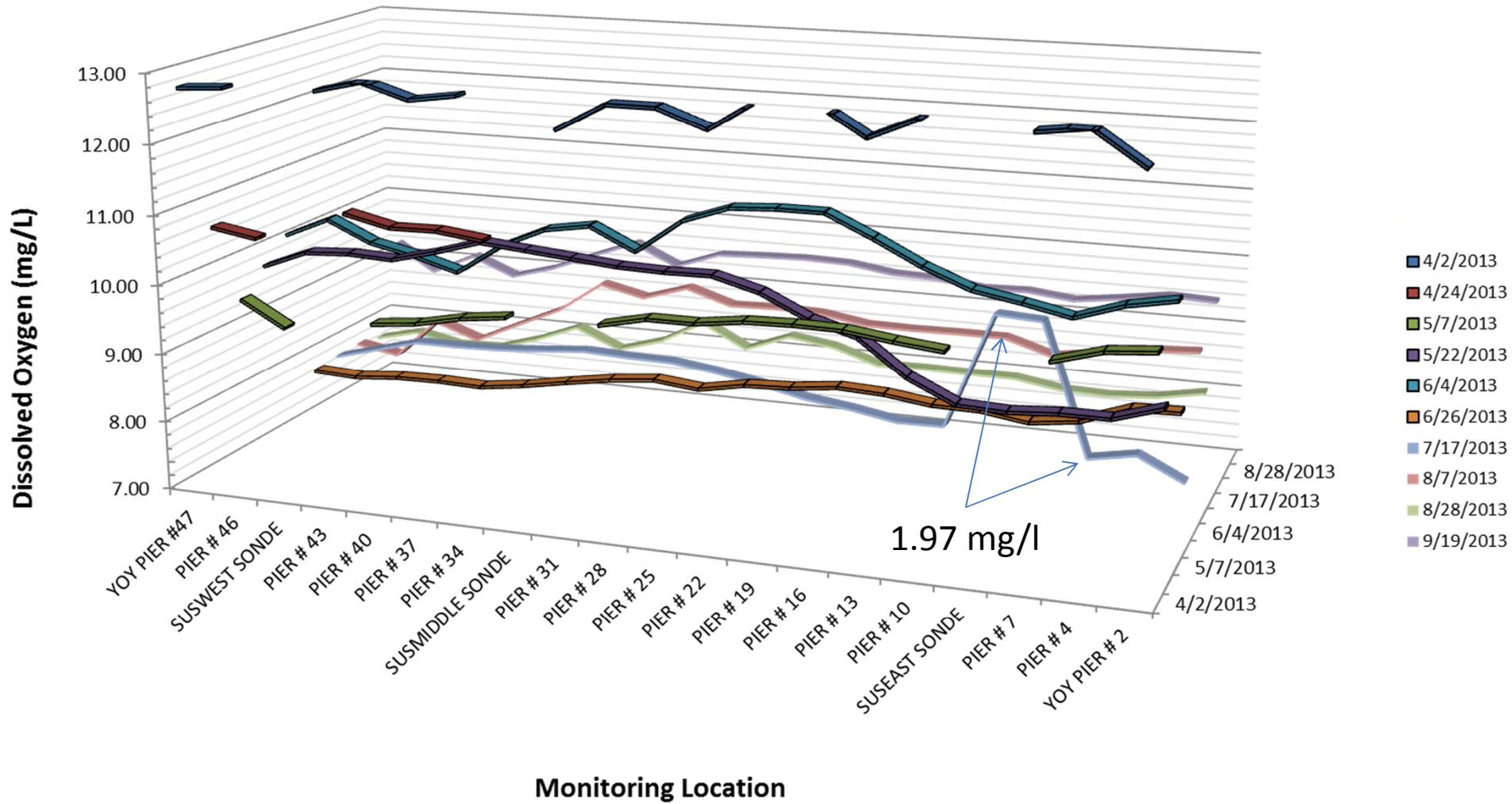
2012 Harrisburg West

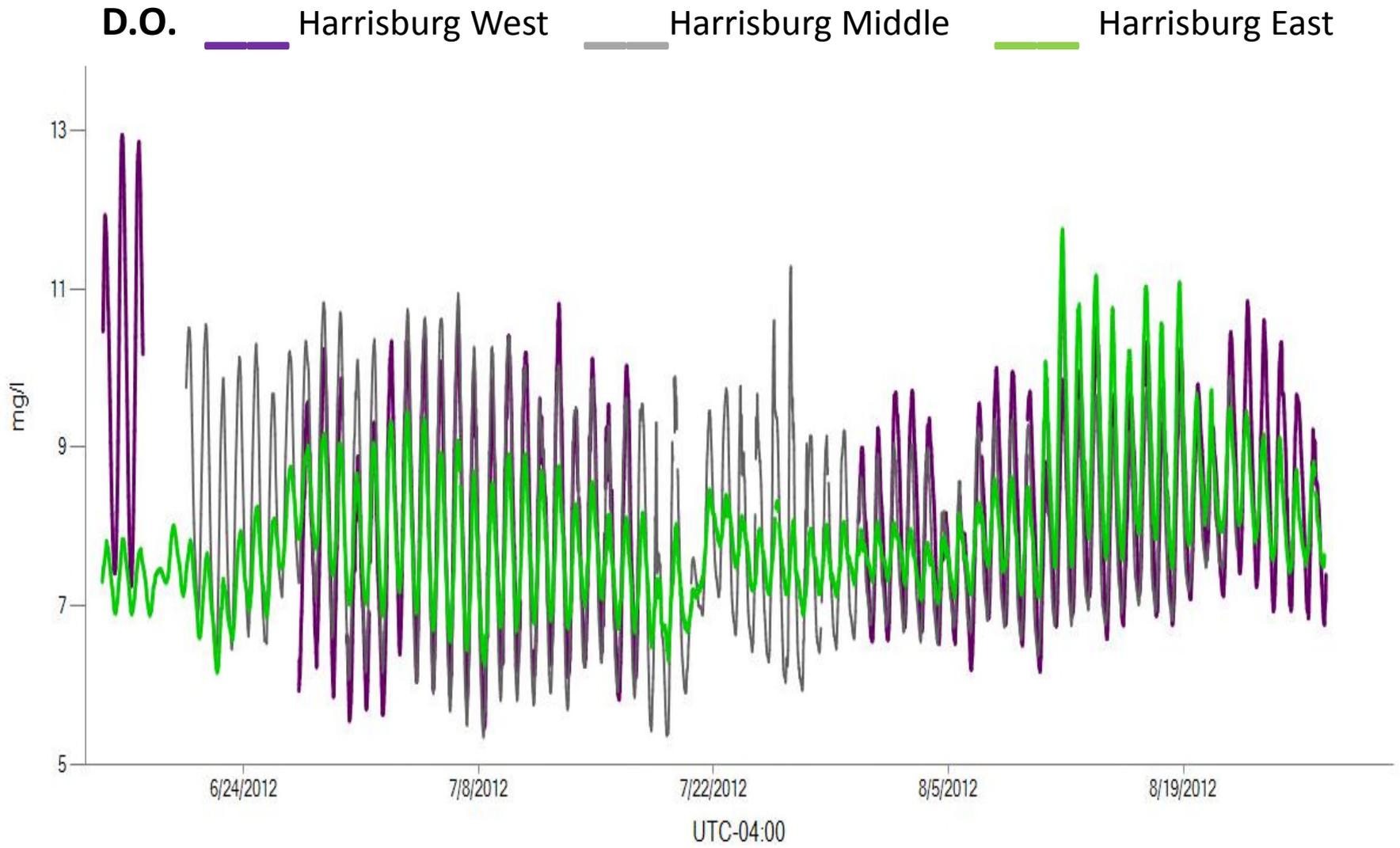


Susquehanna River Harrisburg North Transect – DO (mg/l)



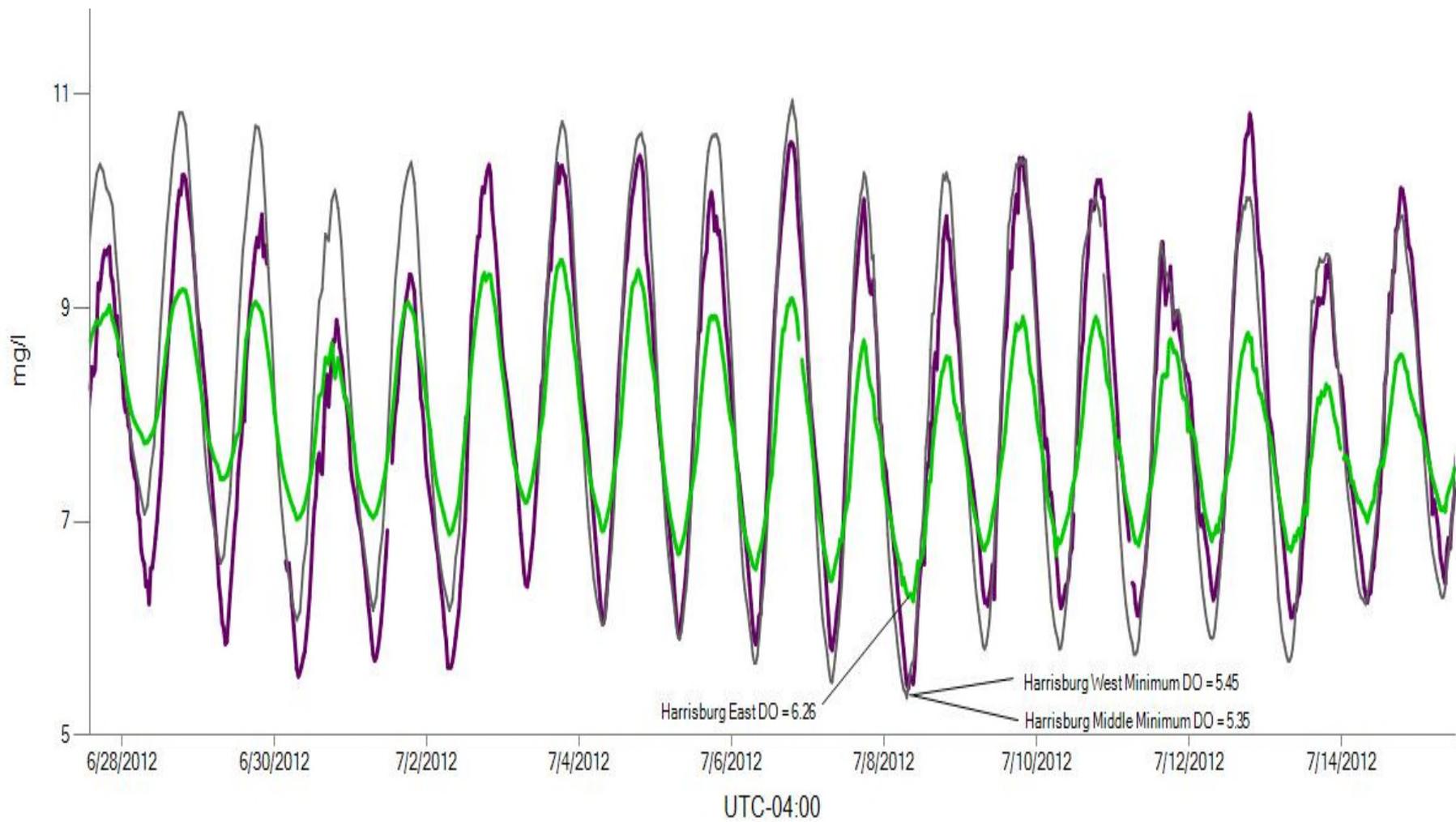
Susquehanna River Rockville Transect - DO (mg/L)



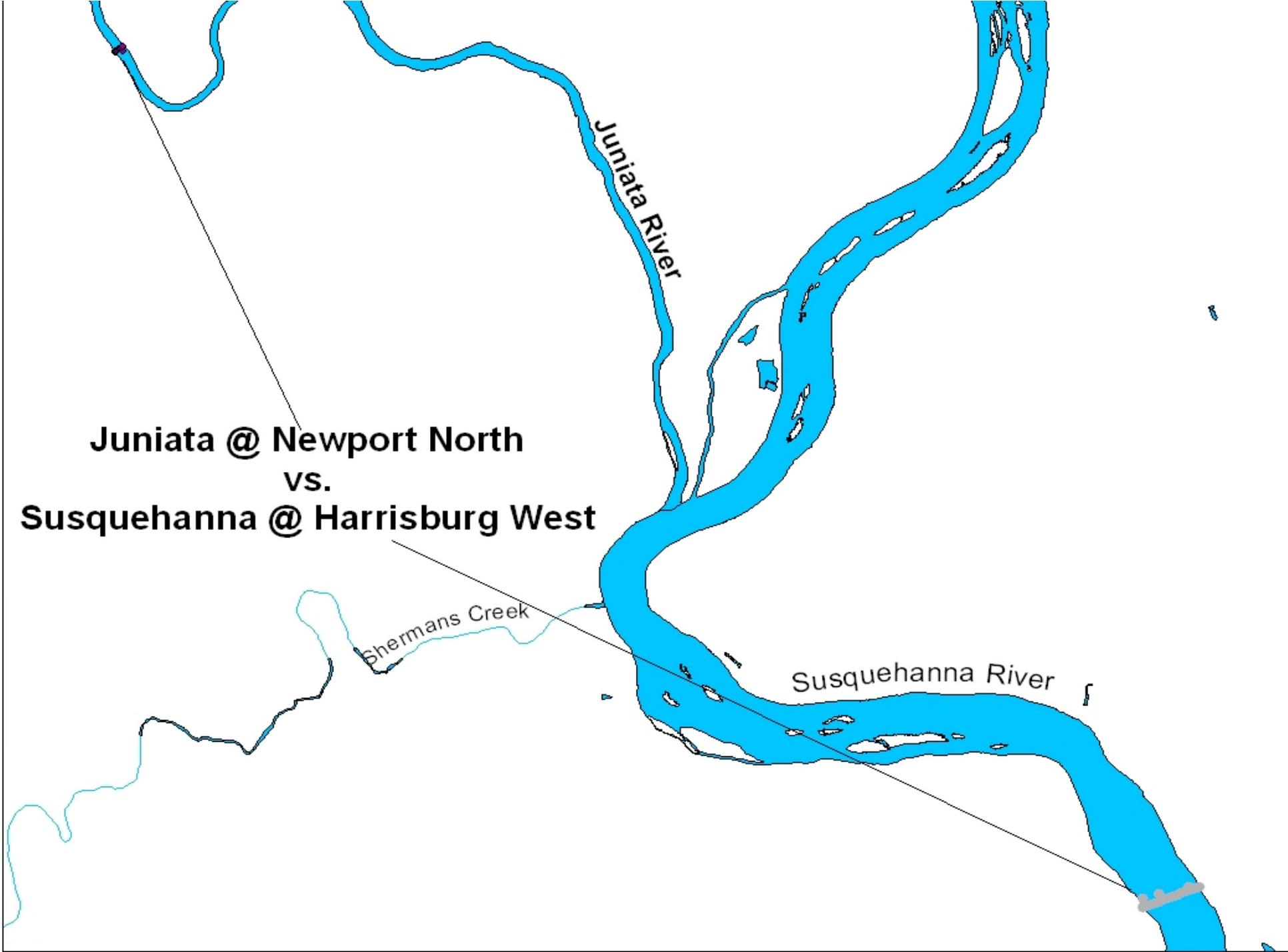


Dissolved Oxygen, Susquehanna at Harrisburg Sample location – 6/14/12-8/31/2012

D.O. — Harrisburg West — Harrisburg Middle — Harrisburg East



Minima Dissolved Oxygen, Susquehanna at Harrisburg Sample location – 6/27/12-7/15/2012



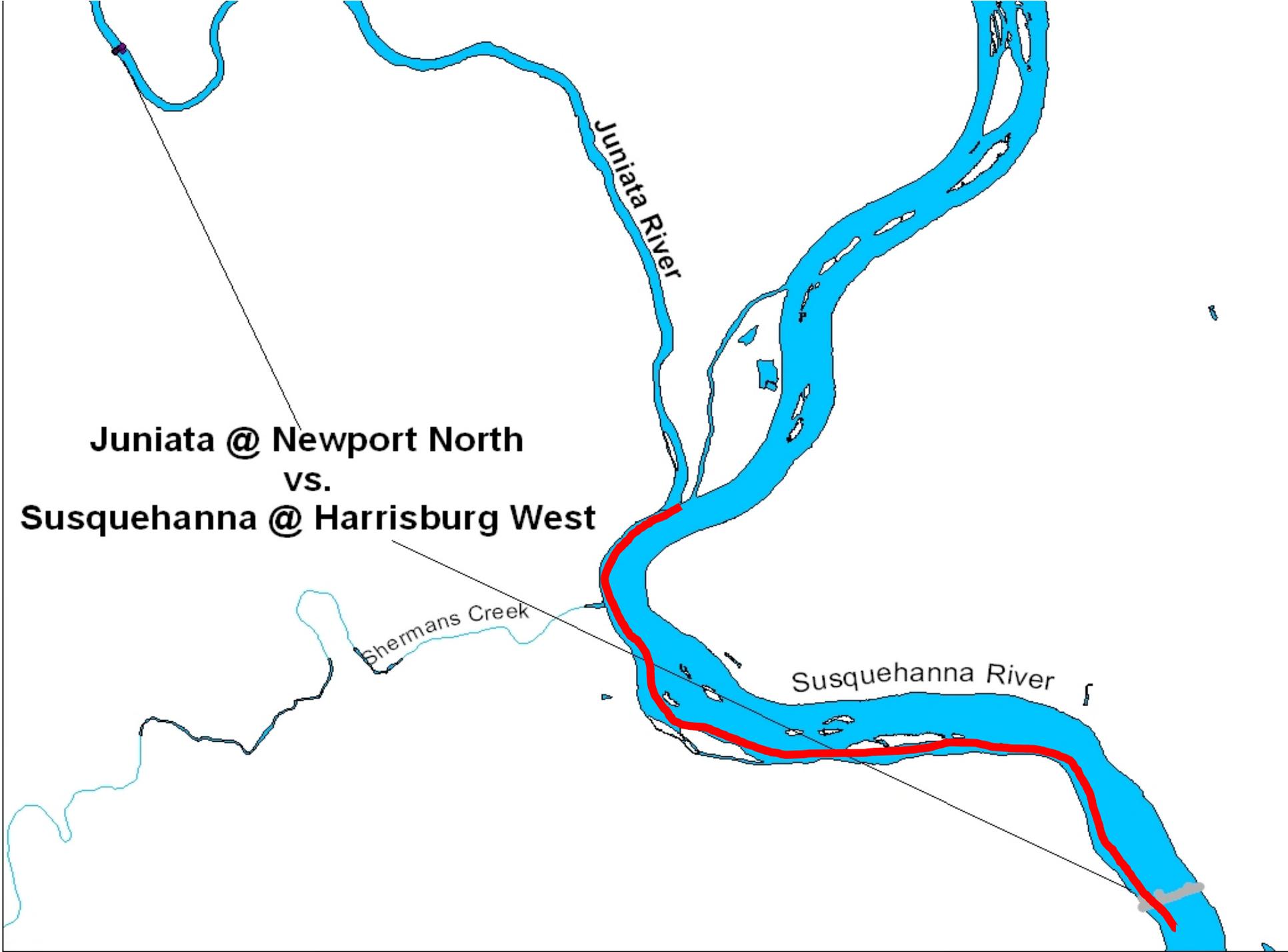
**Juniata @ Newport North
vs.**

Susquehanna @ Harrisburg West

Juniata River

Shermans Creek

Susquehanna River



Juniata River

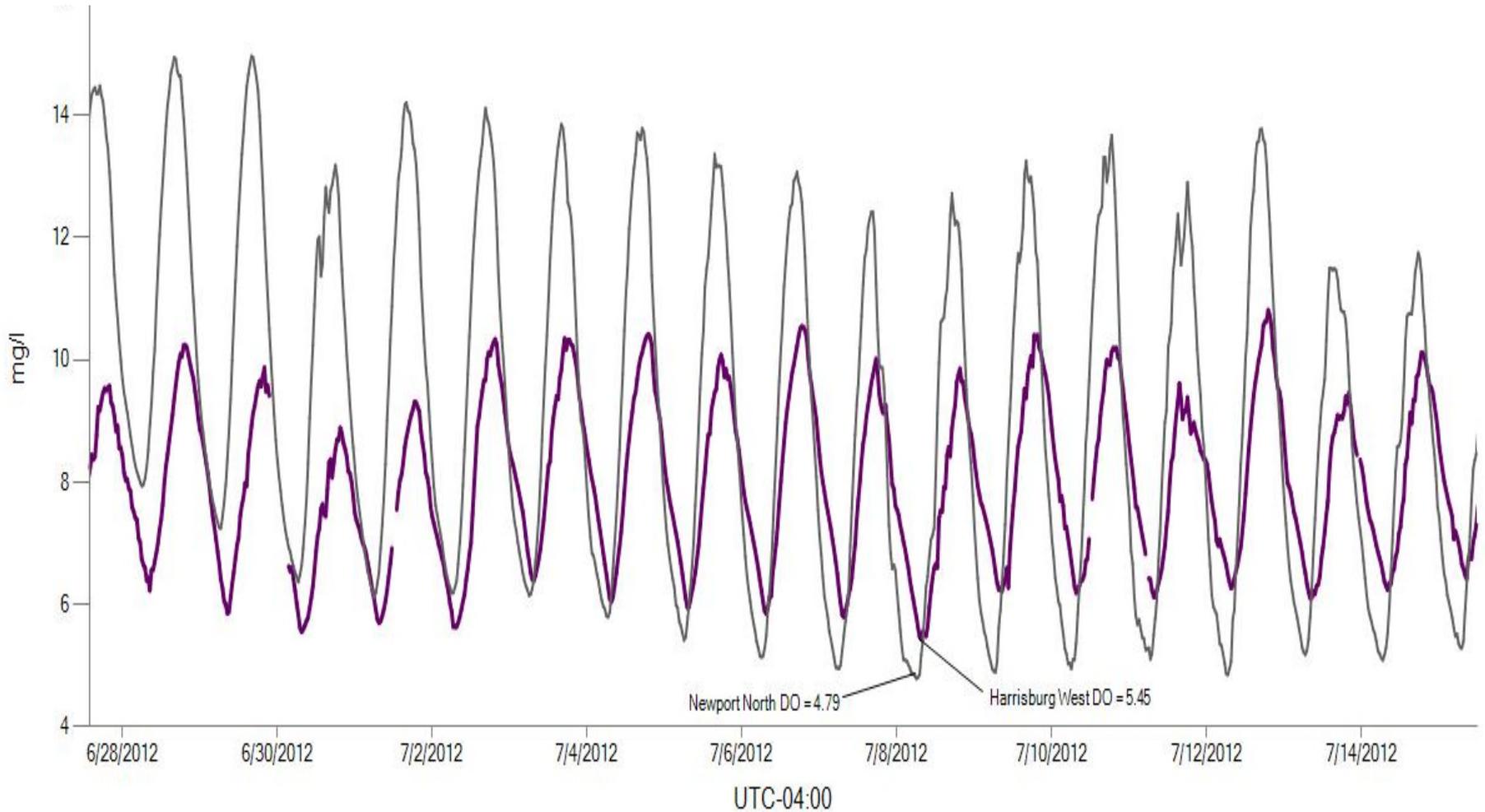
**Juniata @ Newport North
vs.**

Susquehanna @ Harrisburg West

Shermans Creek

Susquehanna River

D.O. — Harrisburg West — Newport North



Minima Dissolved Oxygen, Susquehanna at Harrisburg West and Juniata River at Newport
Sample location – 6/25/12-7/15/2012

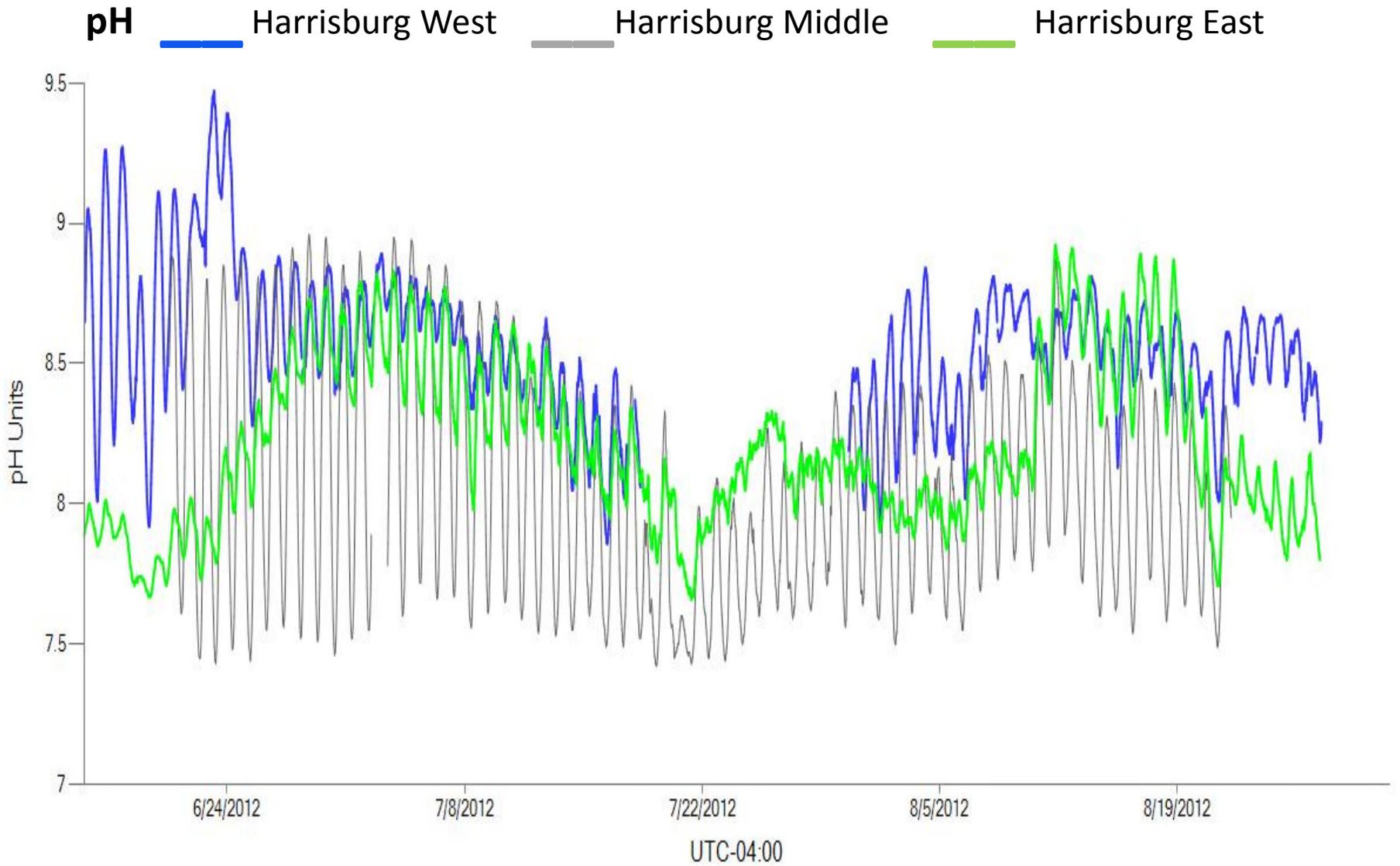


Figure 12. pH, Susquehanna at Harrisburg Sample location – 6/14/12-8/31/2012

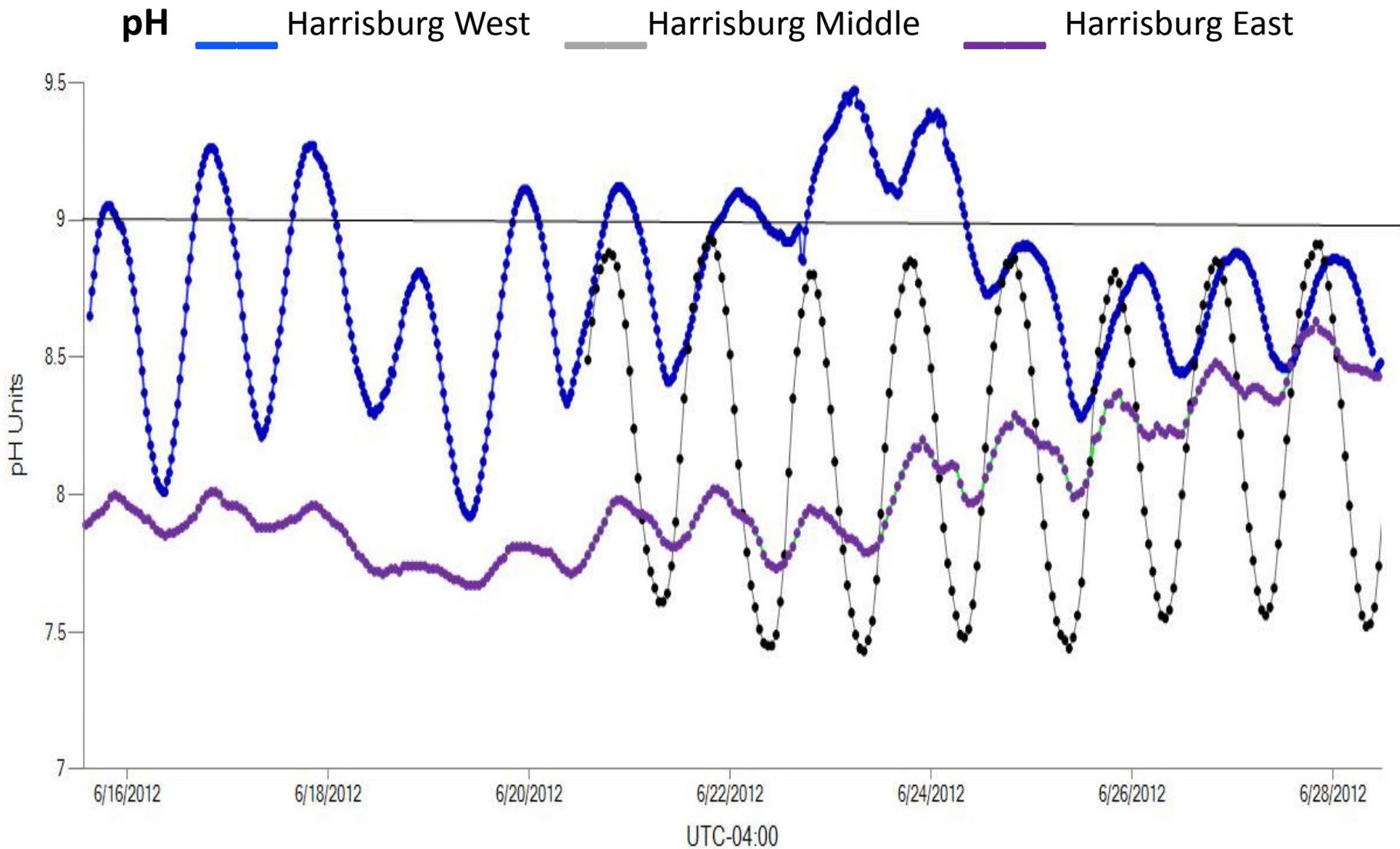


Figure 26. Maxima pH, Susquehanna at Harrisburg Sample Location – 6/15/12-6/29/2012

Evaluation of CIM Data

Certain standards must be met in order to properly assess data from CIMs.

- Quality assurance protocols must be followed.
- Instruments must be periodically calibrated and the final readings corrected for drift.
- The analytical uncertainty is the ability the instrument to discriminate between small differences in a measurement. This uncertainty must be considered when an ambient measurement is compared to a numeric WQS criterion.
- The CIMs must be placed in an area that is representative of the stream segment as a whole.

Defining Criteria Exceedance

- Dissolved Oxygen and pH criteria are defined in Pennsylvania's water quality standards in Chapter §93.7.
- These criteria must be met 99% of the time as defined in Chapter §96.3(c) of the water quality standards.
- CIM data is unique in that data can be continuously recorded at 15, 30 or 60 minute intervals.
- Period of evaluation is one year. If a CIM is not deployed for an entire year then there **must be justification for extrapolating the available results to a year**. In this case, the CIMs were deployed during the critical time of year (low flows and warm temperatures) when dissolved oxygen is lowest and pH highest.

Defining Criteria Exceedance

The table below characterizes common sampling rates or how often data is recorded and the number of criteria exceedances that would be expected for impairment of a water.

Sample Rate	Sample Exceedances Expected for Impairment
15 Minutes	351
30 Minutes	176
60 Minutes	89

Defining Criteria Exceedance

The table below characterizes common sampling rates or how often data is recorded and the number of criteria exceedances that would be expected for impairment of a water.

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15 Minutes	351
30 Minutes	176
60 Minutes	89

Summary of CIM Data 2012

Percent Criteria Exceedances for pH and Dissolved Oxygen CIM data. **Percentage greater than 1.00 is impairment.**

Sample Site 2012	Parameter	% Criteria Exceedance
Delaware East	pH	1.81
Delaware East	Dissolved Oxygen	0
Delaware West	pH	0.23
Delaware West	Dissolved Oxygen	0
Juniata Newport	pH	0.7
Juniata Newport	Dissolved Oxygen	0
Susquehanna Harrisburg West	pH	0.36
Susquehanna Harrisburg West	Dissolved Oxygen	0
Susquehanna Harrisburg Middle	pH	0
Susquehanna Harrisburg Middle	Dissolved Oxygen	0
Susquehanna Harrisburg East	pH	0
Susquehanna Harrisburg East	Dissolved Oxygen	0
Susquehanna Sunbury West	pH	0
Susquehanna Sunbury West	Dissolved Oxygen	0
Susquehanna Sunbury East	pH	0
Susquehanna Sunbury East	Dissolved Oxygen	0

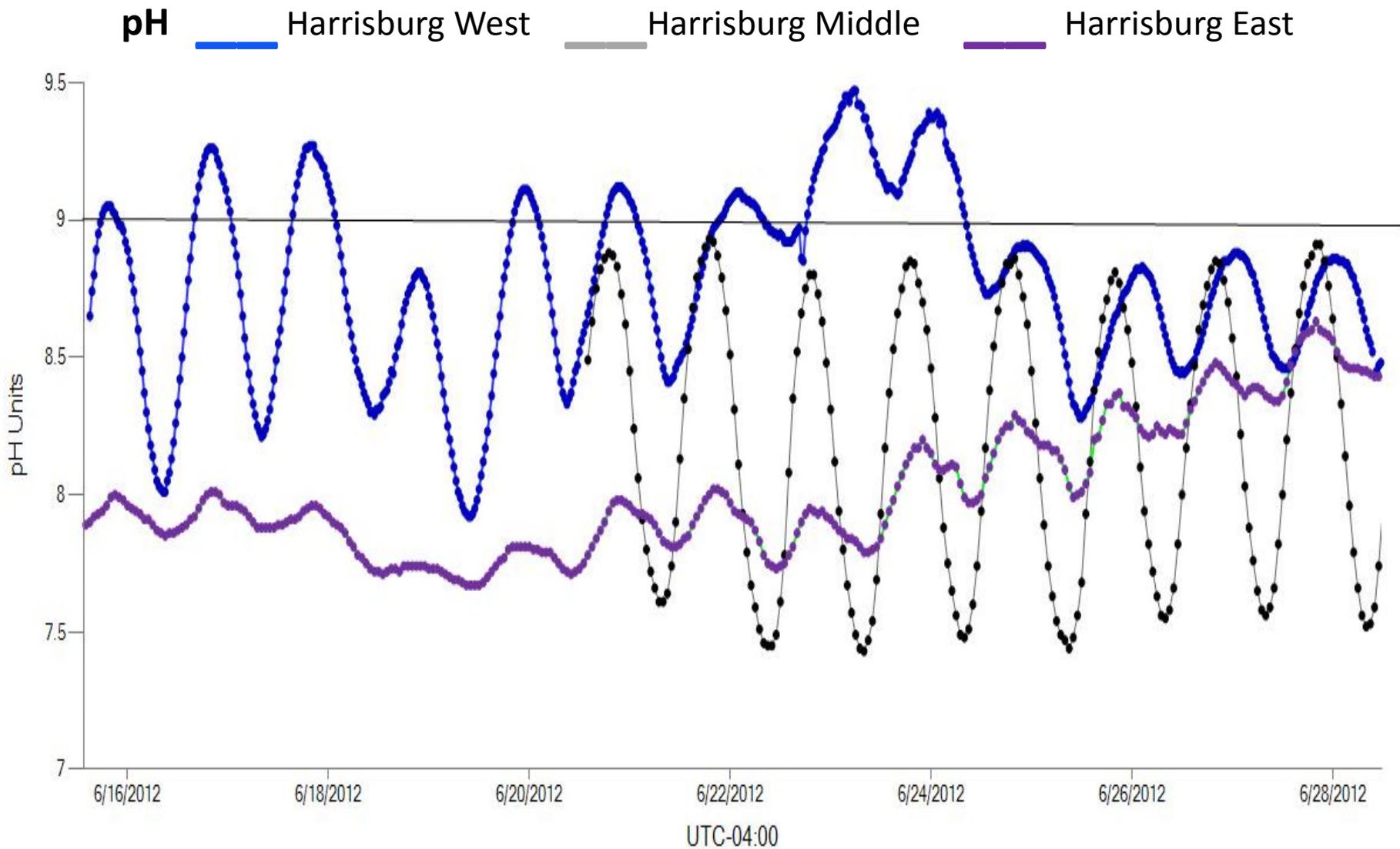
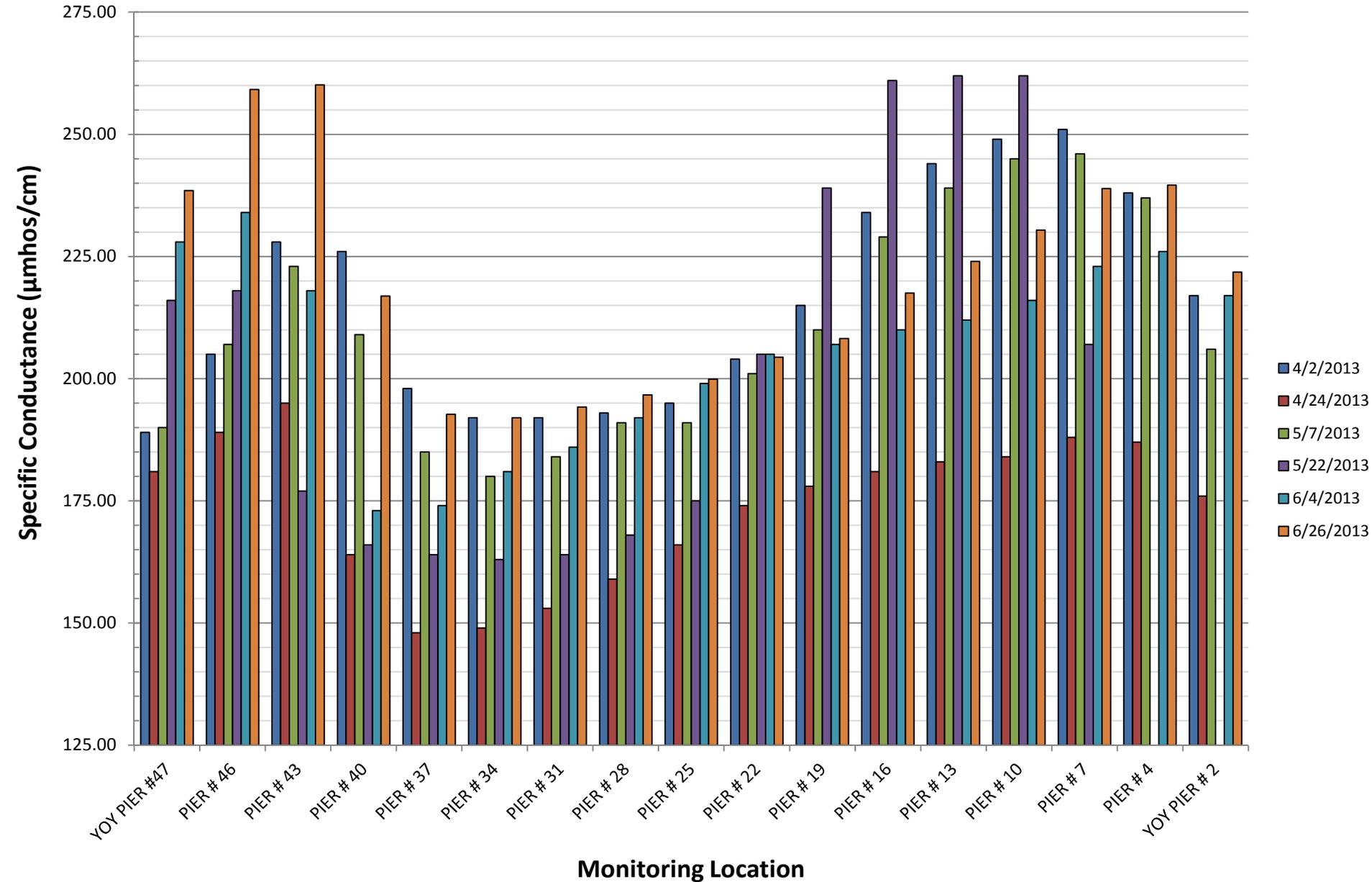
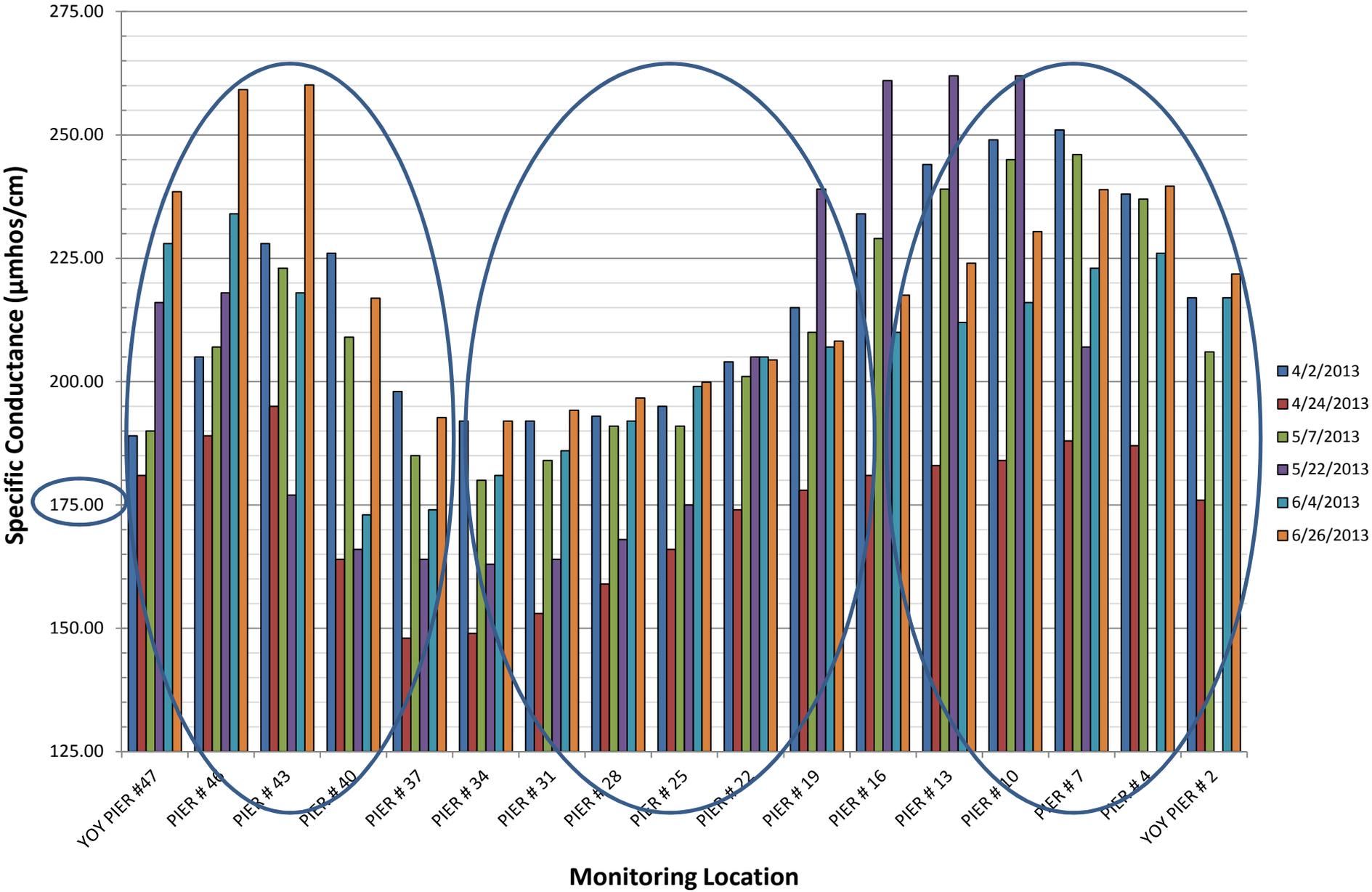


Figure 26. Maxima pH, Susquehanna at Harrisburg Sample Location – 6/15/12-6/29/2012

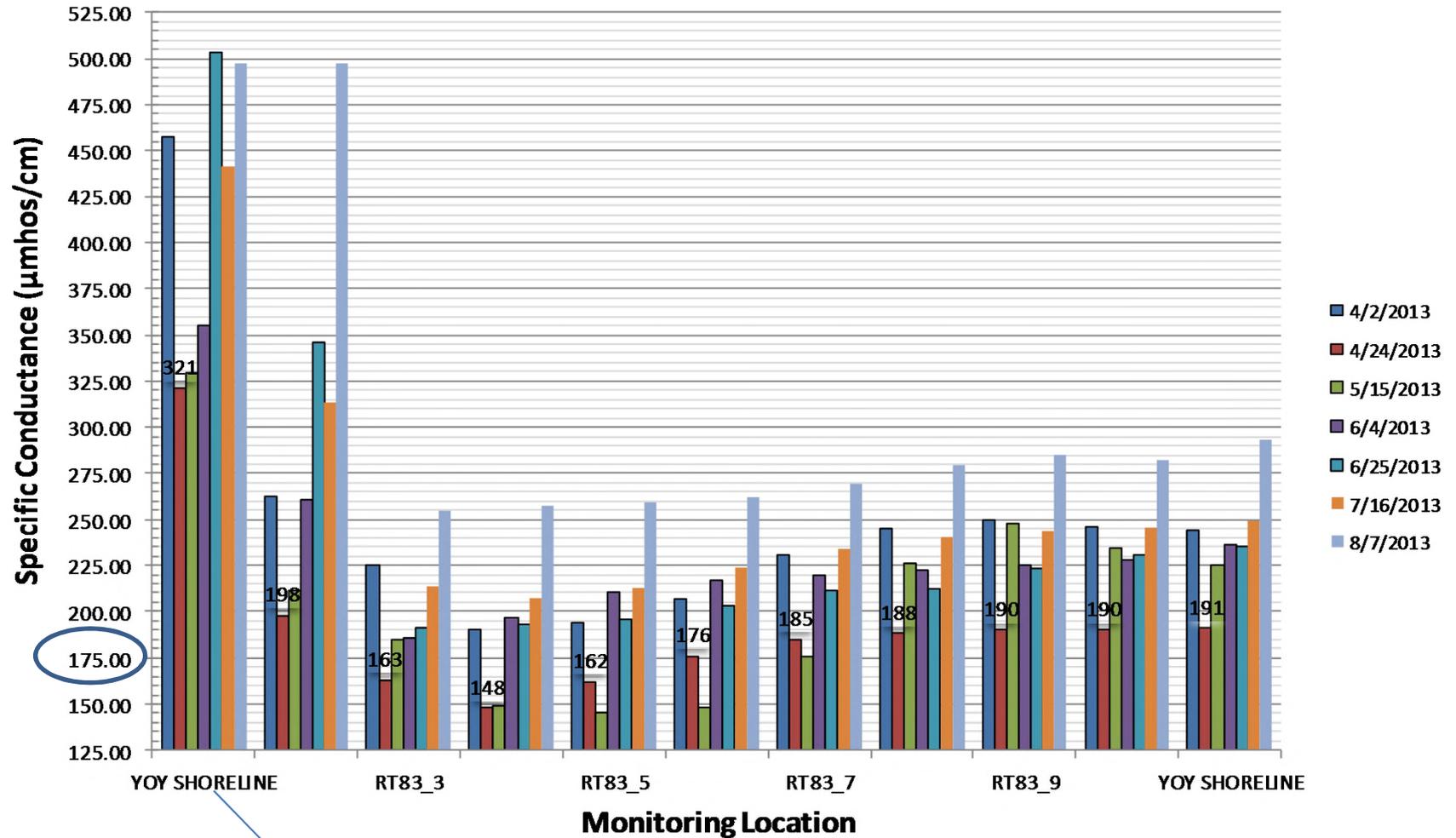
Susquehanna River Rockville Transect - Specific Conductance ($\mu\text{mhos/cm}$)



Susquehanna River Rockville Transect - Specific Conductance (μmhos/cm)



Susquehanna River Route 83 Transect - Specific Conductance ($\mu\text{mhos/cm}$)



This is just downstream of a PFBC YOY Site



2013 Harrisburg East

2013 Harrisburg Middle

2013 Harrisburg West

2013 Water Quality Transects

2012 Random Site

2012 Harrisburg East

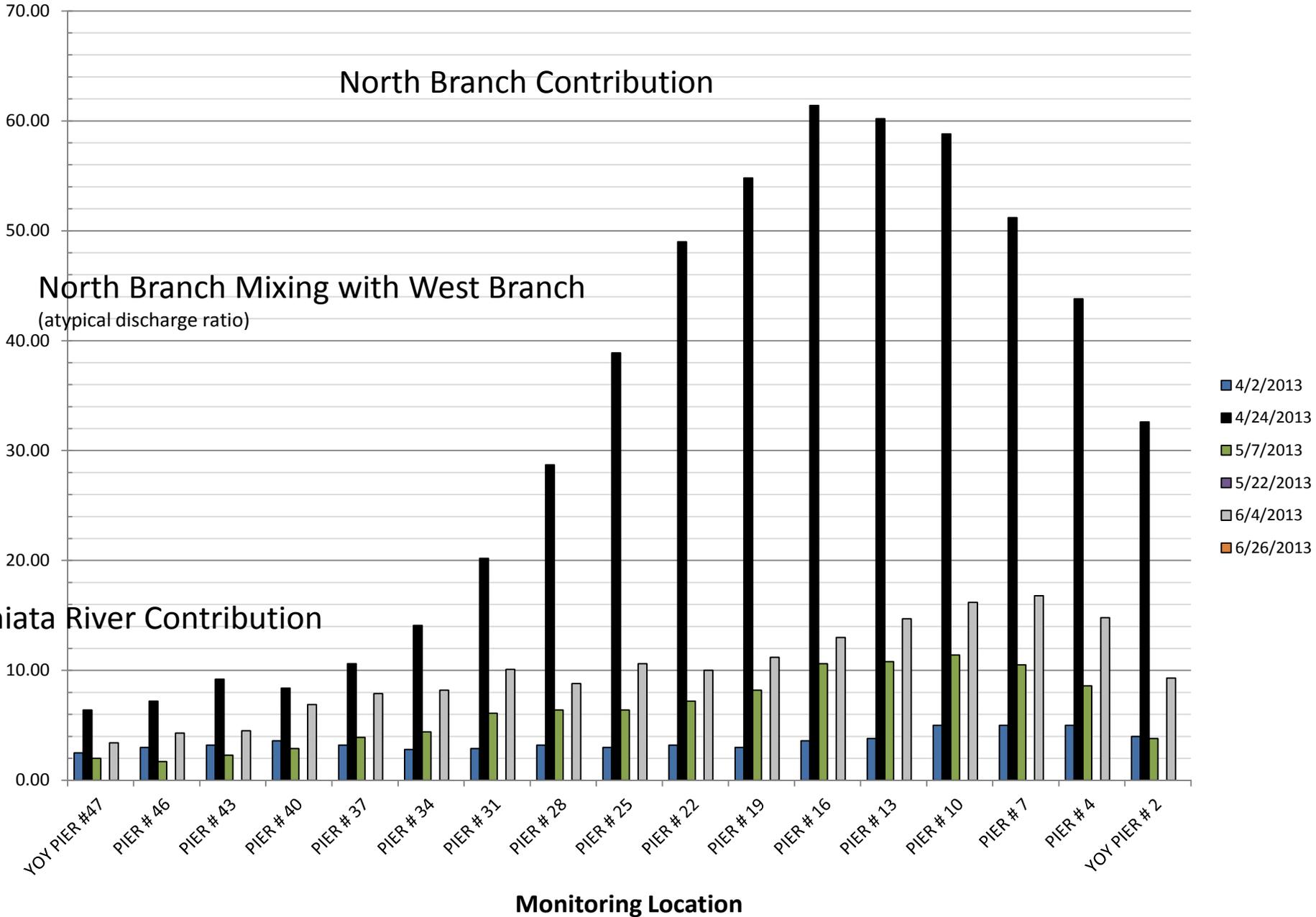
2012 Harrisburg Middle

2012 Harrisburg West



Added Turbidity to Harrisburg Sites in 2013

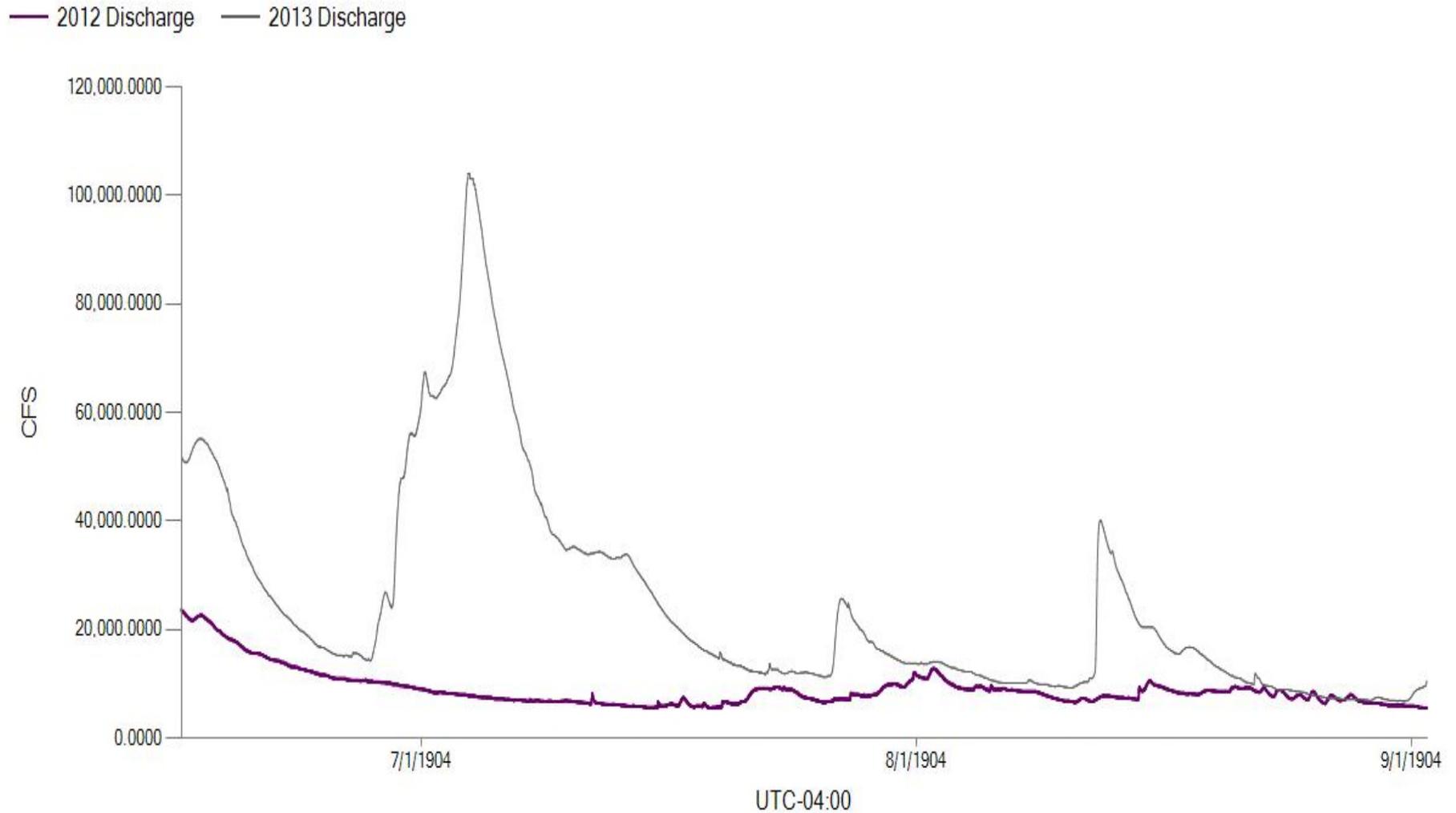
Susquehanna River Rockville Transect - Turbidity (NTU)

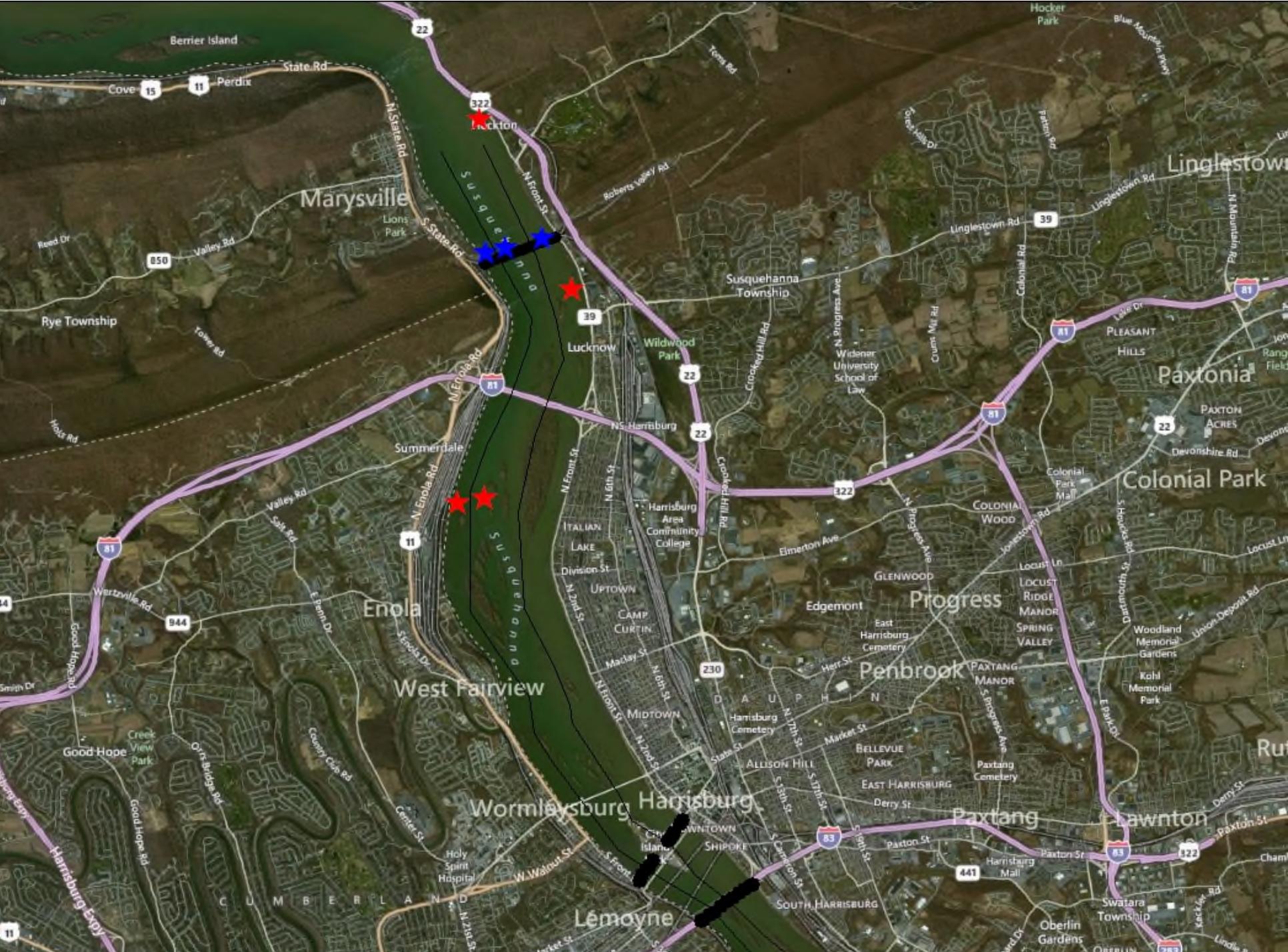


2013 turbidity CIM data did not meet “usable criteria” after review.



Discharge at Harrisburg 2012 vs. 2013





Rockton

Marysville

Enola

West Fairview

Wormleysburg Harrisburg

Lemoyne

Progress

Penbrook

Paxtang

Lawnton

Linglestown

Paxtonia

Colonial Park

Ruthton

Berrier Island

Cove

Perdit

State Rd

Valley Rd

Yower Rd

Hoss Rd

Wartville Rd

Good Hope Rd

Valley Rd

Salix Rd

E Smith Dr

Orin Bridge Rd

Creekside Park

Good Hope Rd

Orin Bridge Rd

Good Hope Rd

Good Hope Rd

Good Hope Rd

Lions Park

Roberts Valley Rd

N Front St

Wildwood Park

Susquehanna Township

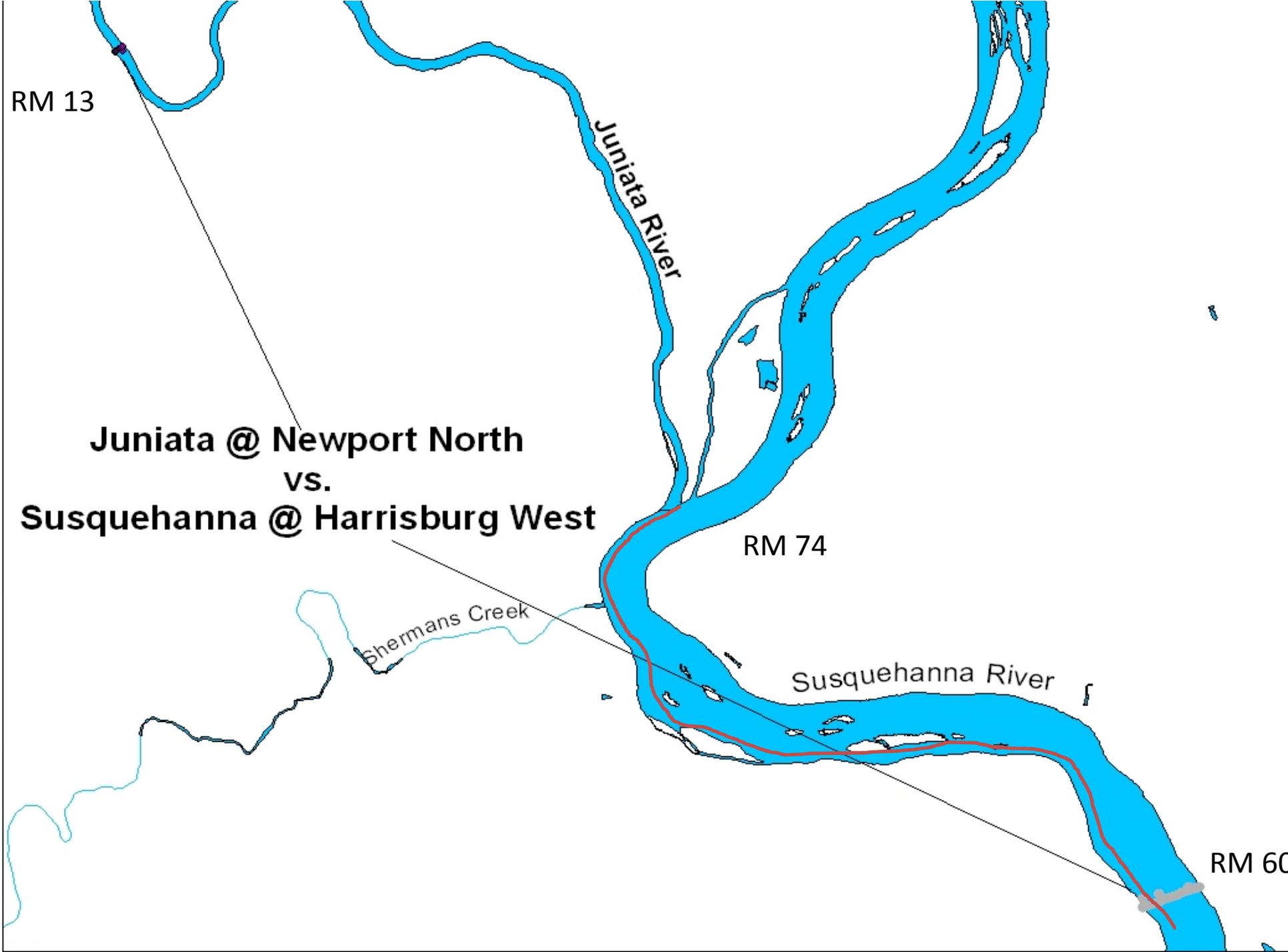
Widener University School of Law

Linglestown Rd

Colonial Rd

Pleasant Hills

Devonshire Rd



RM 13

Juniata River

**Juniata @ Newport North
vs.
Susquehanna @ Harrisburg West**

Shermans Creek

RM 74

Susquehanna River

RM 60

2012-13 Juniata River @ Newport



2012-13 Water Quality Transect

2012-13 Newport North

2012-13 Newport South

Associated Water Chemistry 2012

- Total Suspended Solids
- Ammonia Dissolved as Nitrogen
- Ammonia Total as Nitrogen
- Kjeldahl Nitrogen, Dissolved
- Kjeldahl Nitrogen, Total as Nitrogen
- Nitrate & Nitrite, Total as Nitrogen
- Nitrate & Nitrite, Dissolved as Nitrogen
- Phosphorus, Total as P
- Phosphorus, Dissolved as P
- Phosphorus Ortho Dissolved

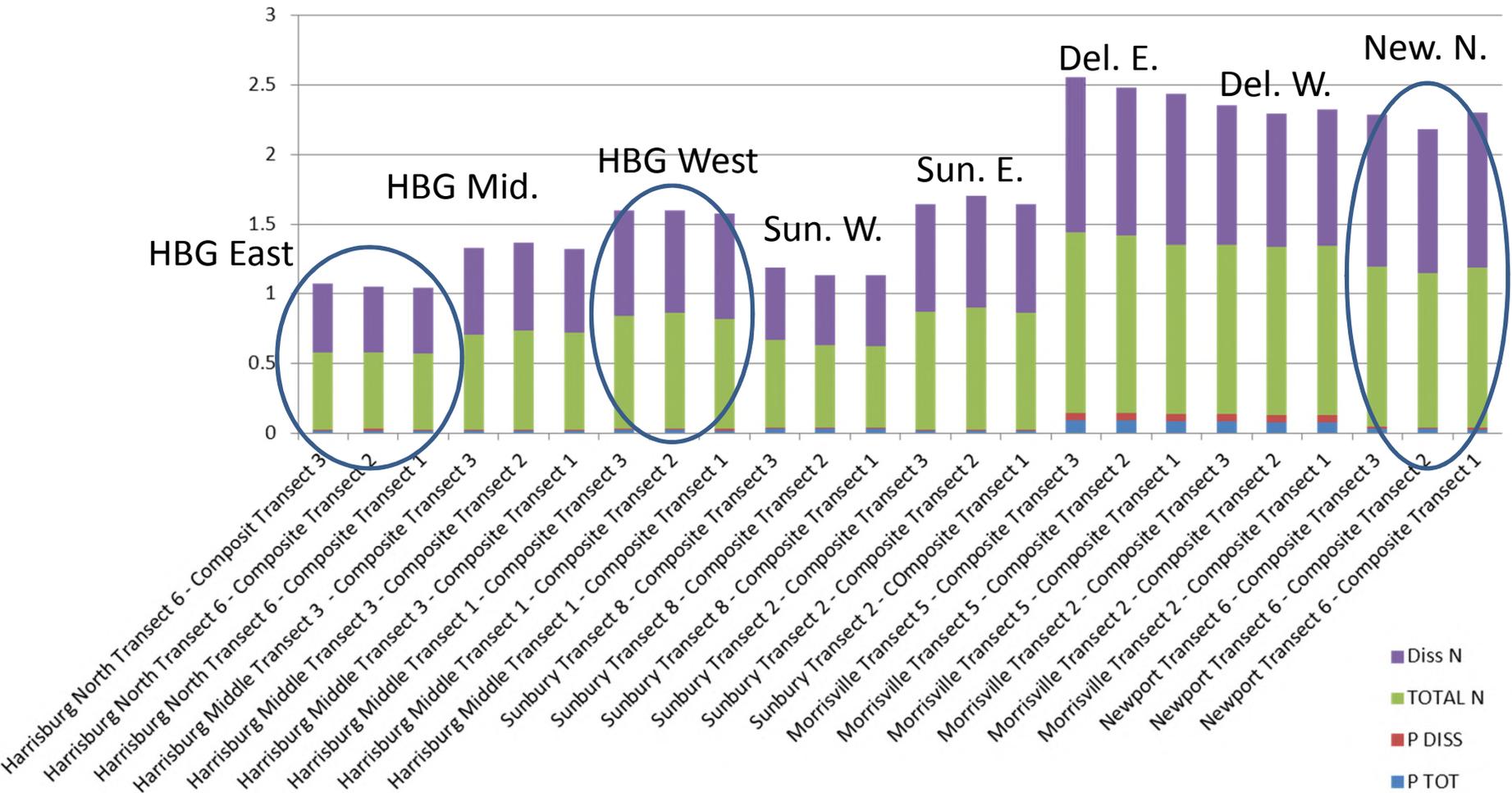


Associated Water Chemistry 2013

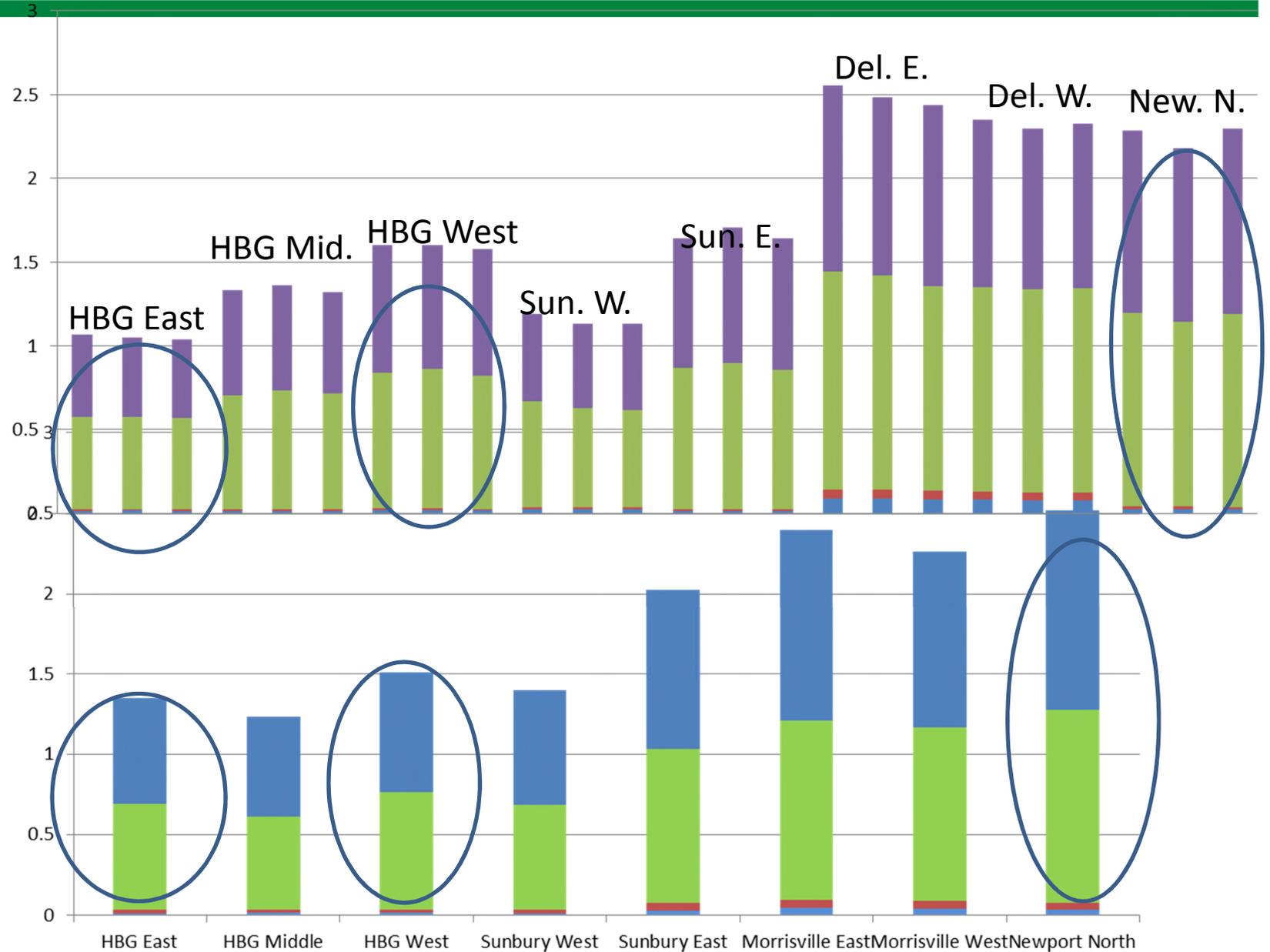
* Bay Loading Suite

- Total Suspended Solids
- Total Dissolved Solids
- Nitrogen, Total and Dissolved
- Ammonia, Total & Dissolved as N
- Nitrate & Nitrite, Total & Dis. as N
- Phosphorus, Total and Dissolved
- Phosphorus Ortho, Total & Dissolved
- Total Organic Carbon
- Hardness
- Calcium, Total
- Magnesium, Total
- Sodium
- Chloride
- Sulfate
- Barium
- Boron
- Copper, Total
- Iron, Total
- Lead, Total
- Manganese, Total
- Nickel, Total
- Strontium
- Zinc, Total
- Aluminum, Total
- Selenium
- Osmotic Pressure
- Bromide

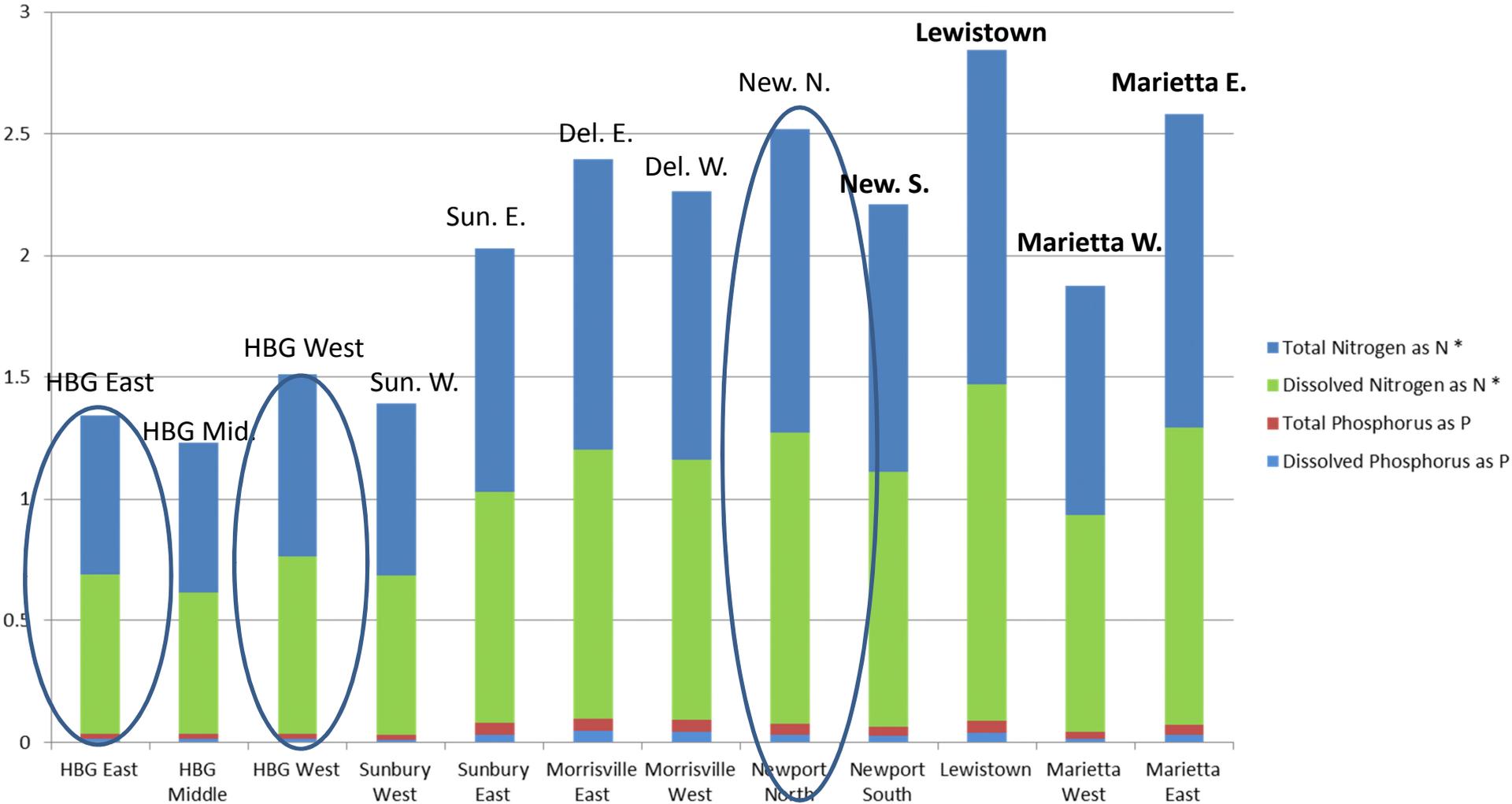
Associated Water Chemistry 2012



Associated Water Chemistry 2012-13



Associated Water Chemistry 2013



Periphyton(Algal/Diatom) Sampling



Periphyton(Algal/Diatom) Sampling

Very good indicator of nutrient inputs and associated in-stream production.

Algae and diatoms have the ability to luxury uptake and store nutrients for later use. This can characterize nutrient loading over a period of time more efficiently than standard water chemistry grab samples.



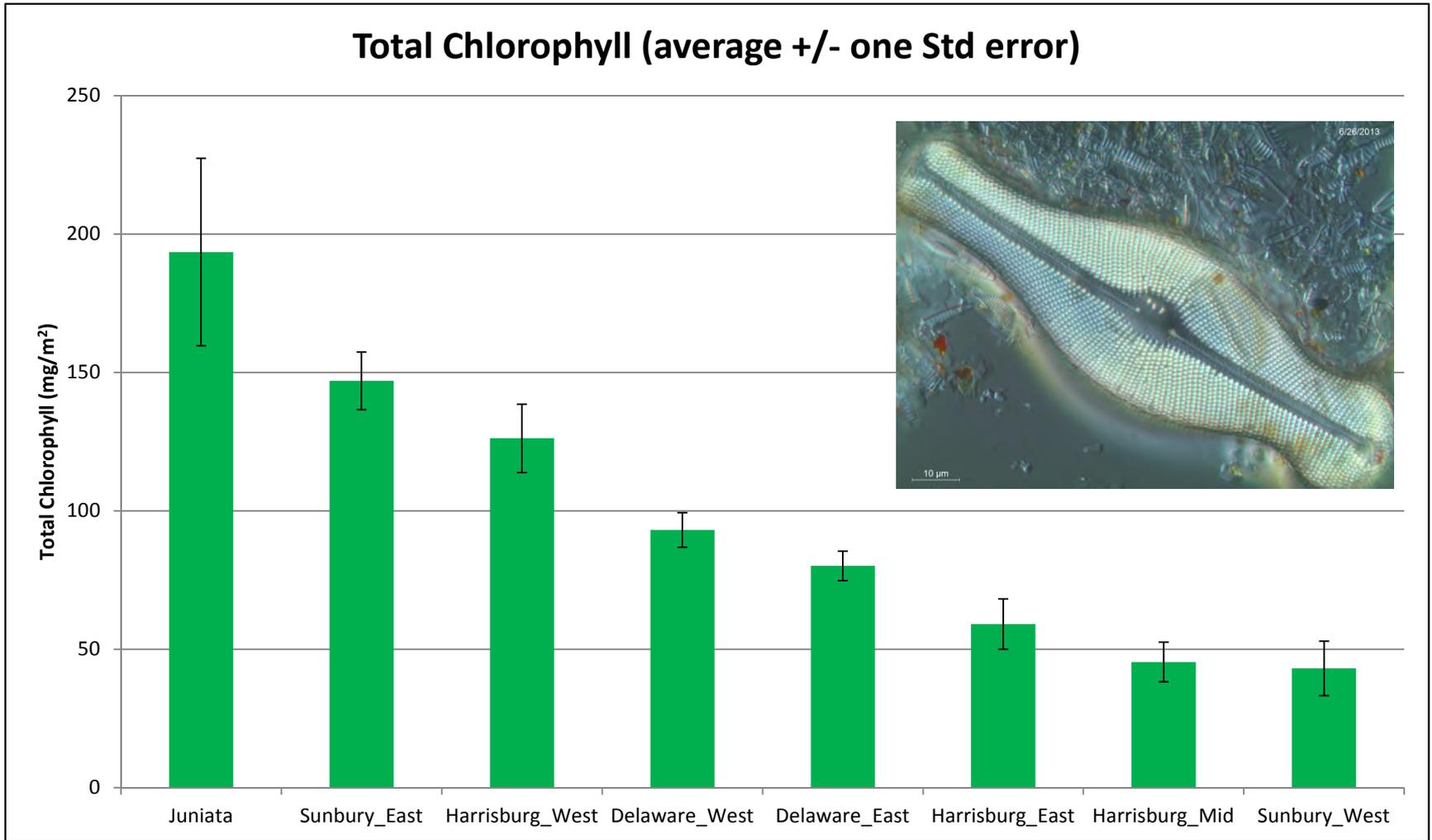
▶ Periphyton Block & Tile(s) Artificial Substrate Sampler



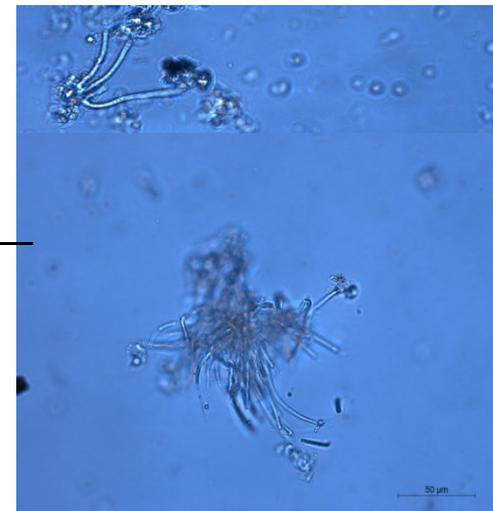
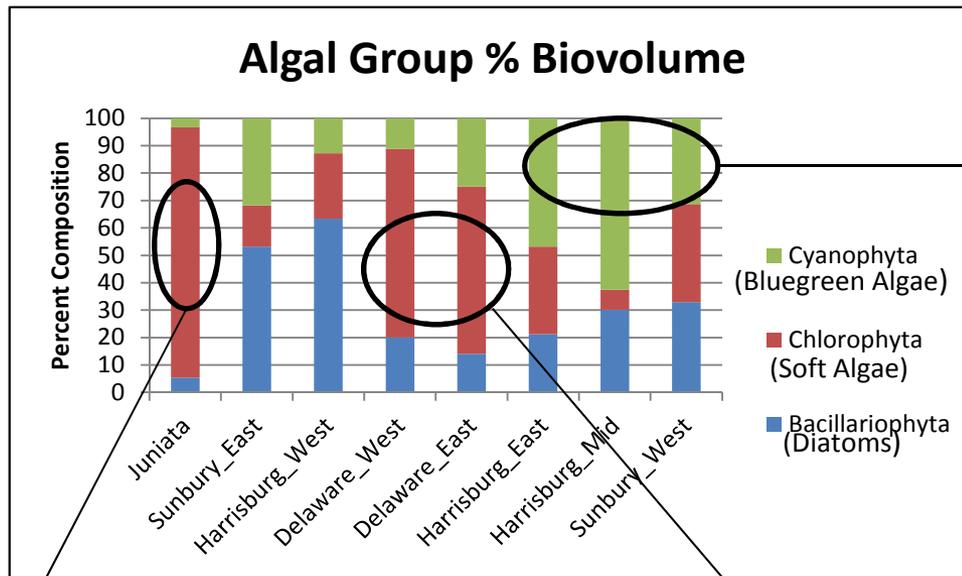
Natural Substrate Periphyton Sampling



Total Chlorophyll in Large Rivers Systems: Preliminary 2012 TMDL Periphyton Sampling Results



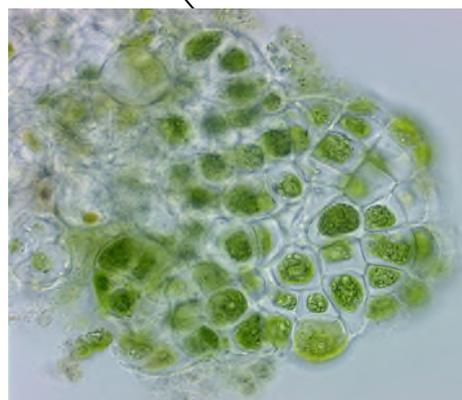
Algal Composition in Large Rivers Systems: Preliminary 2012 TMDL Periphyton Sampling Results



Homeothrix janthina
Filamentous bluegreen alga
Grows under low nutrients
Modifies benthic habitat



Cladophora glometata
Filamentous green alga
Grows under high nutrients
Modifies benthic habitat



Coleochaete sp.
Parenchymous green alga
Grows under high nutrients
Modifies benthic habitat

Benthic Macroinvertebrates

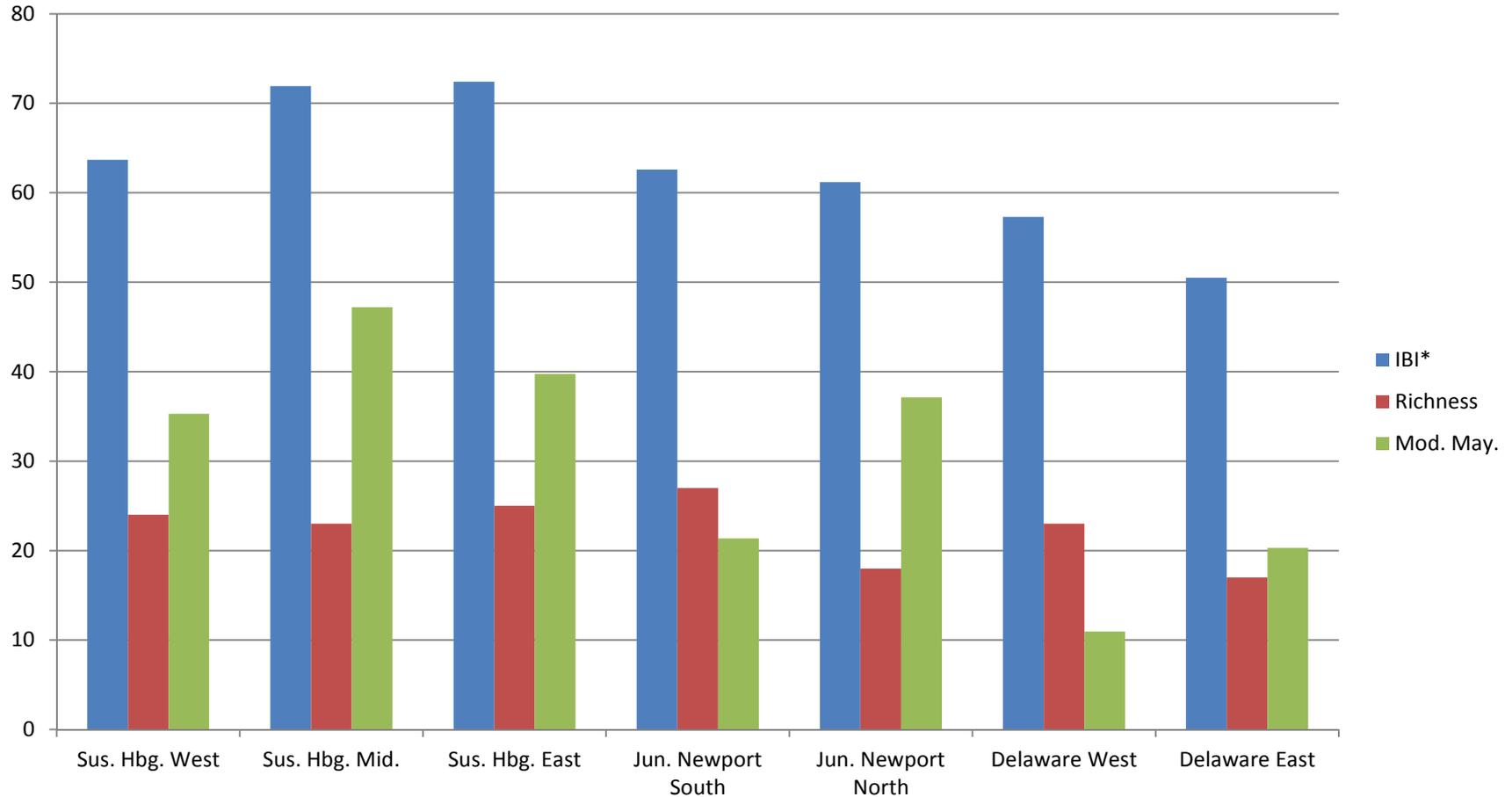
2012 Sampled Core Locations = 7 sites



2013 Sampled Many More Locations = approx. 37 sites



2012 Preliminary Macroinvertebrate Results



Mussel Surveys

Susquehanna River

1. Wilkes-Barre 2012
2. Danville 2012
3. Sunbury 2013 – 3 Sites (1 zebra mussel found)
4. Liverpool 2012
5. Harrisburg 2013 – 3 Sites
6. Goldsboro 2012

West Branch Susquehanna River

1. Jersey Shore 2013 – 2 Sites
2. Williamsport 2012
3. Lewisburg 2013 – 2 Sites (Young *Elliptio Complanata* found, Possible eel stocking success)

Juniata River

1. Lewistown 2013 – 2 Sites
2. Newport 2013 – 2 Sites



Routine Fish Tissue

Current Advisories – Susquehanna River

Susquehanna River (Susquehanna Co.)	Entire section in PA from the NY border above Starrucca Creek to the NY border below Great Bend	Smallmouth bass Fallfish	2 meals/month	Mercury
Susquehanna River (Bradford and Wyoming Co.)	NY border above Sayre to PA Route 92 bridge at Falls	Walleye Smallmouth bass	1 meal/month	Mercury
		Channel catfish	1 meal/month	PCB
Susquehanna River (Wyoming, Lackawanna, Luzerne, Columbia, Northumberland, and Montour Co.)	PA Route 92 bridge at Falls to confluence with West Branch	Smallmouth bass	2 meals/month	Mercury
		All suckers	Do Not Eat	PCB
		Channel catfish Quillback Carp Walleye	1 meal/month	



Routine Fish Tissue

Changes for 2014 – Susquehanna River

Susquehanna River (Susquehanna Co.)	Entire section in PA from the NY border above Starrucca Creek to the NY border below Great Bend	Smallmouth bass Fallfish	2 meals/month	Mercury
Susquehanna River (Bradford and Wyoming Co.)	NY border above Sayre to PA Route 92 bridge at Falls	Walleye Smallmouth bass	1 meal/month	Mercury
		Channel catfish Carp	1 meal/month	PCB
Susquehanna River (Wyoming, Lackawanna, Luzerne, Columbia, Northumberland, and Montour Co.)	PA Route 92 bridge at Falls to confluence with West Branch	Smallmouth bass	2 meals/month	Mercury
		All suckers	Do Not Eat	PCB
		Channel catfish Quillback Carp Walleye	1 meal/month	
Susquehanna River (Snyder, Northumberland, Juniata, Perry, Dauphin, Cumberland, York, and Lancaster Co.)	West Branch to PA/MD border	Channel catfish over 20"	1 meal/month	PCB

Routine Fish Tissue

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Susquehanna River (Susquehanna Co.)	Entire section in PA from the NY border above Starrucca Creek to the NY border below Great Bend	Smallmouth bass Fallfish	2 meals/month	Mercury
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Routine Fish Tissue

Current Advisories – West BranchSusquehanna River

West Branch Susquehanna River (Clinton, Lycoming, Union and Northumberland Co.)	Bald Eagle Creek to I-80 bridge	Channel catfish	1 meal/month	PCB
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No Changes for 2014



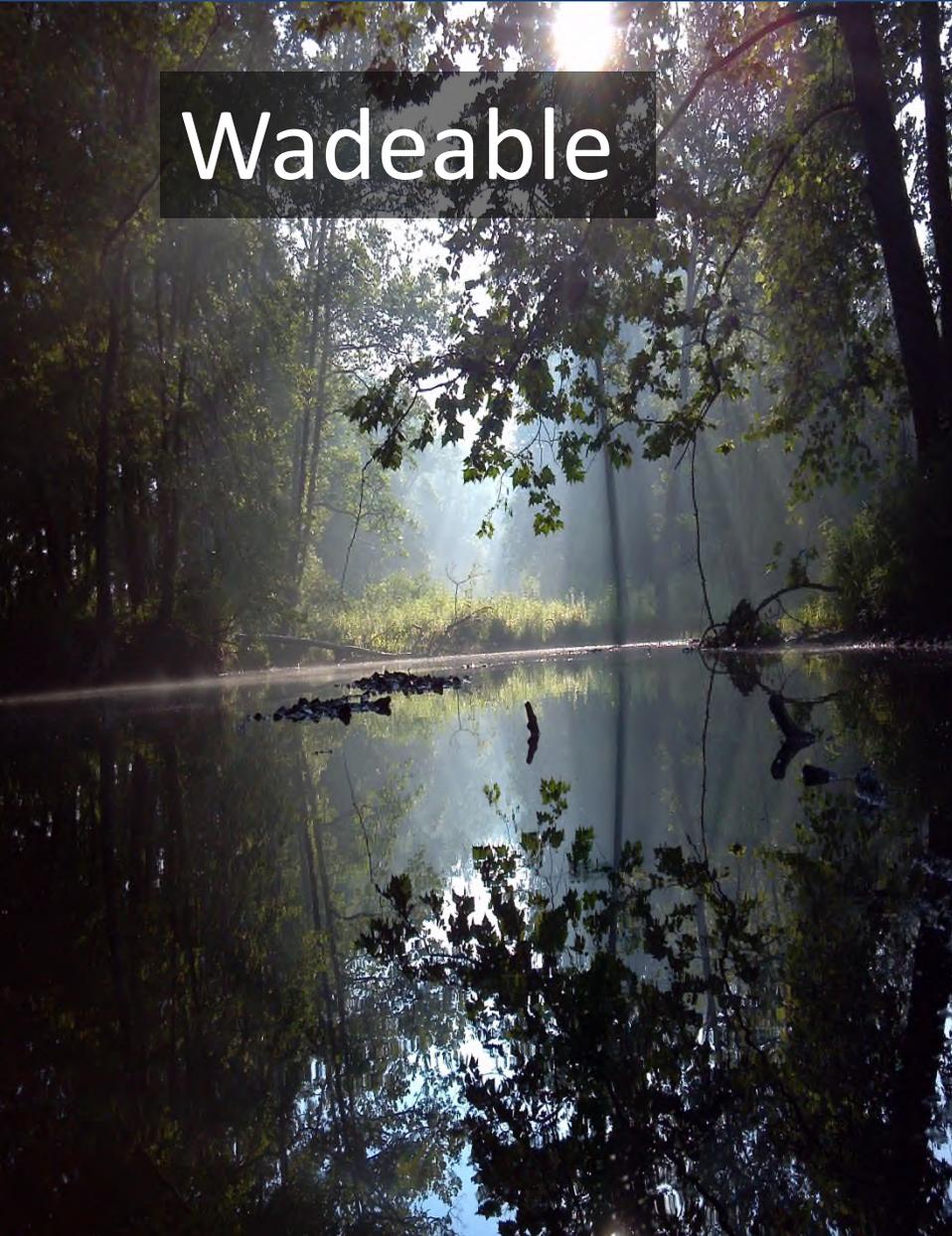


2013

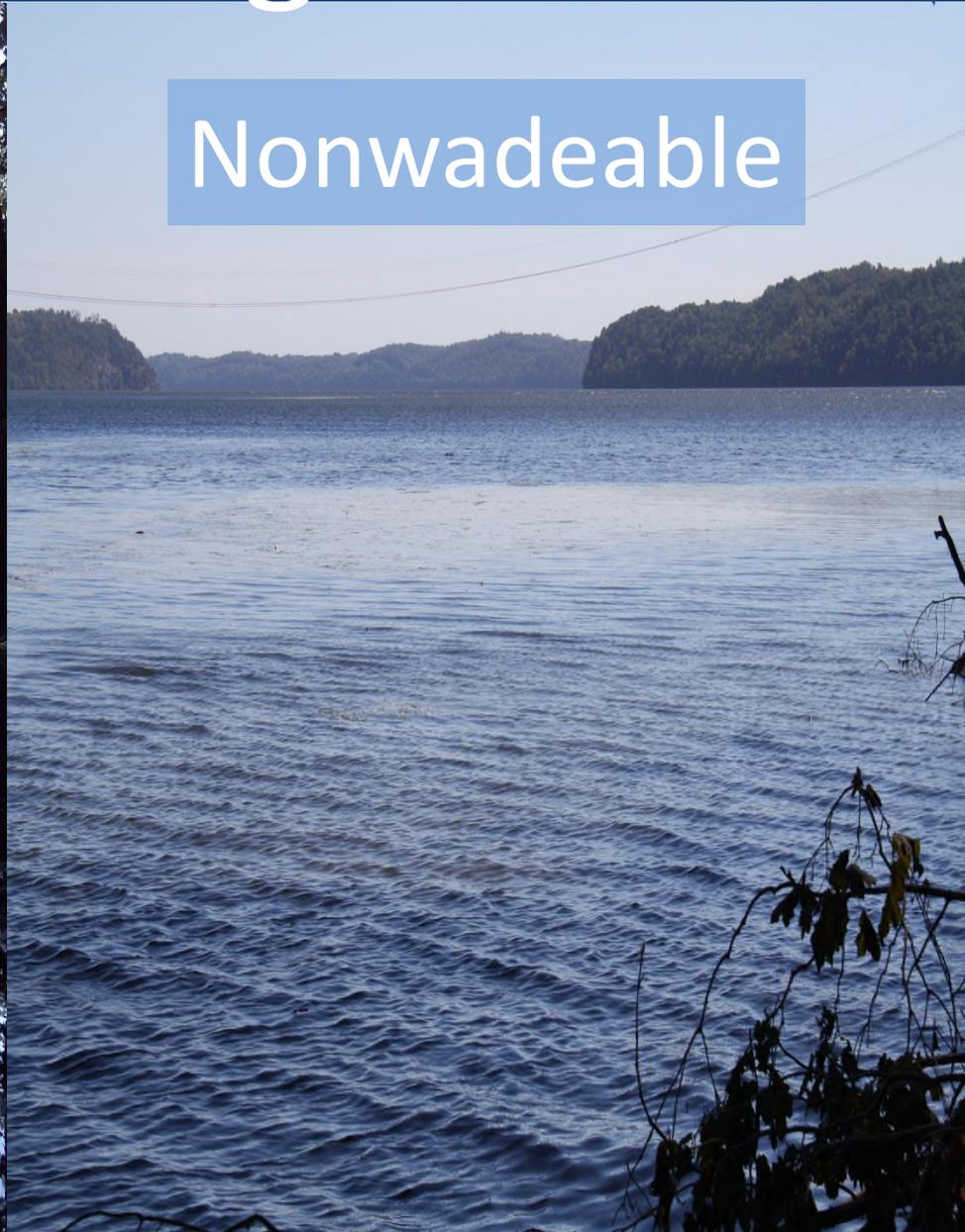
**Susquehanna River Fish
Surveys**

Methodologies

Wadeable



Nonwadeable



Fish Health Assessment

A man wearing a dark blue jacket, a red life vest, and a tan cap is kneeling on a wooden boardwalk by a river. He is holding a small notebook and a pen, looking down at it. In front of him lies a large, dark fish on a wooden board. The background shows a river with some greenery and a tree trunk.

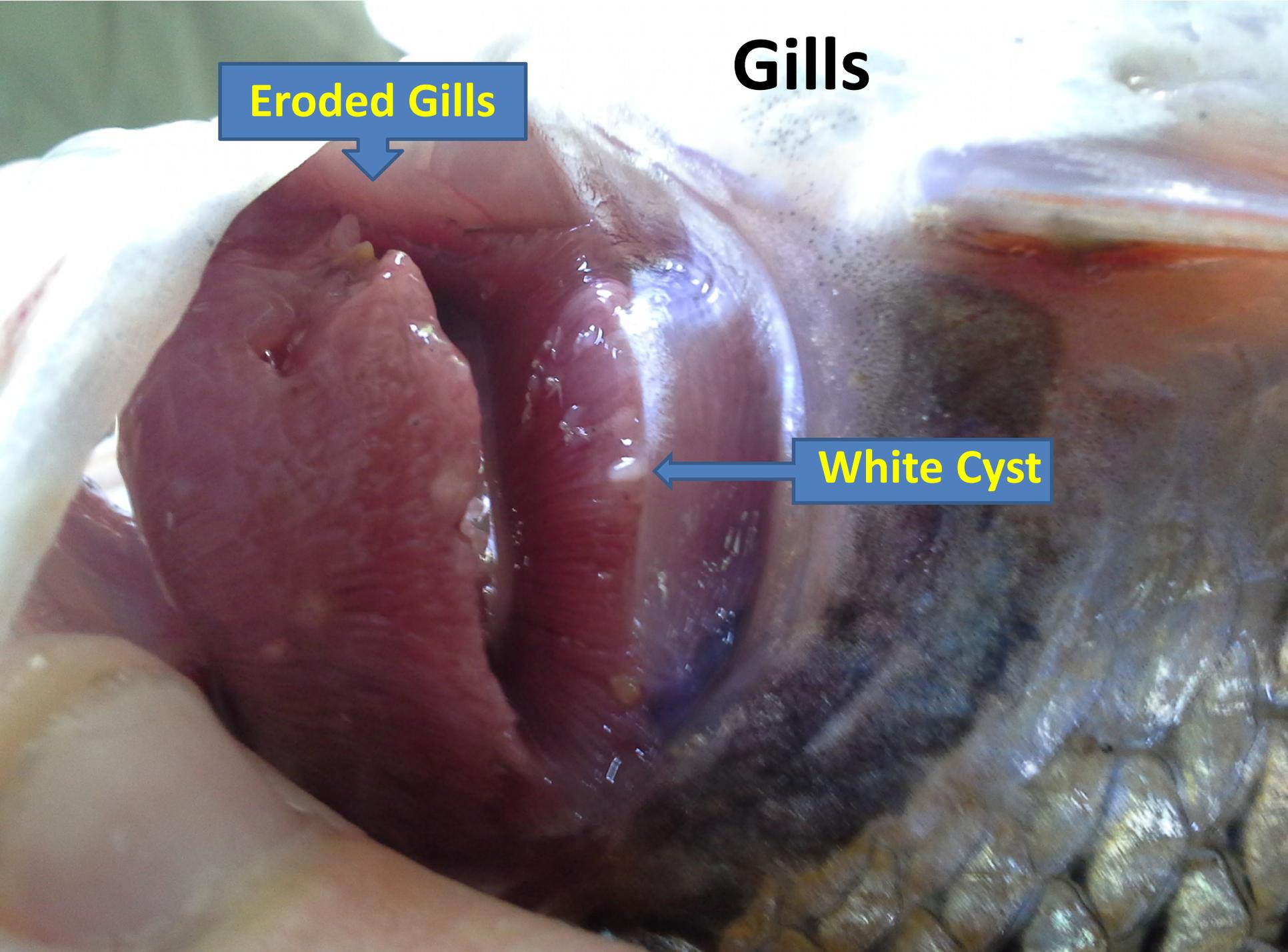
- Adapted from various Federal/State DELT assessments and USGS fish health protocol
- Designed to make a semi-quantitative assessment of fish health at a given location
- Incorporates an “observational” approach to fish health
- Potential data will be a many-to-one approach
- Still in developmental stages

Gills

Eroded Gills



White Cyst



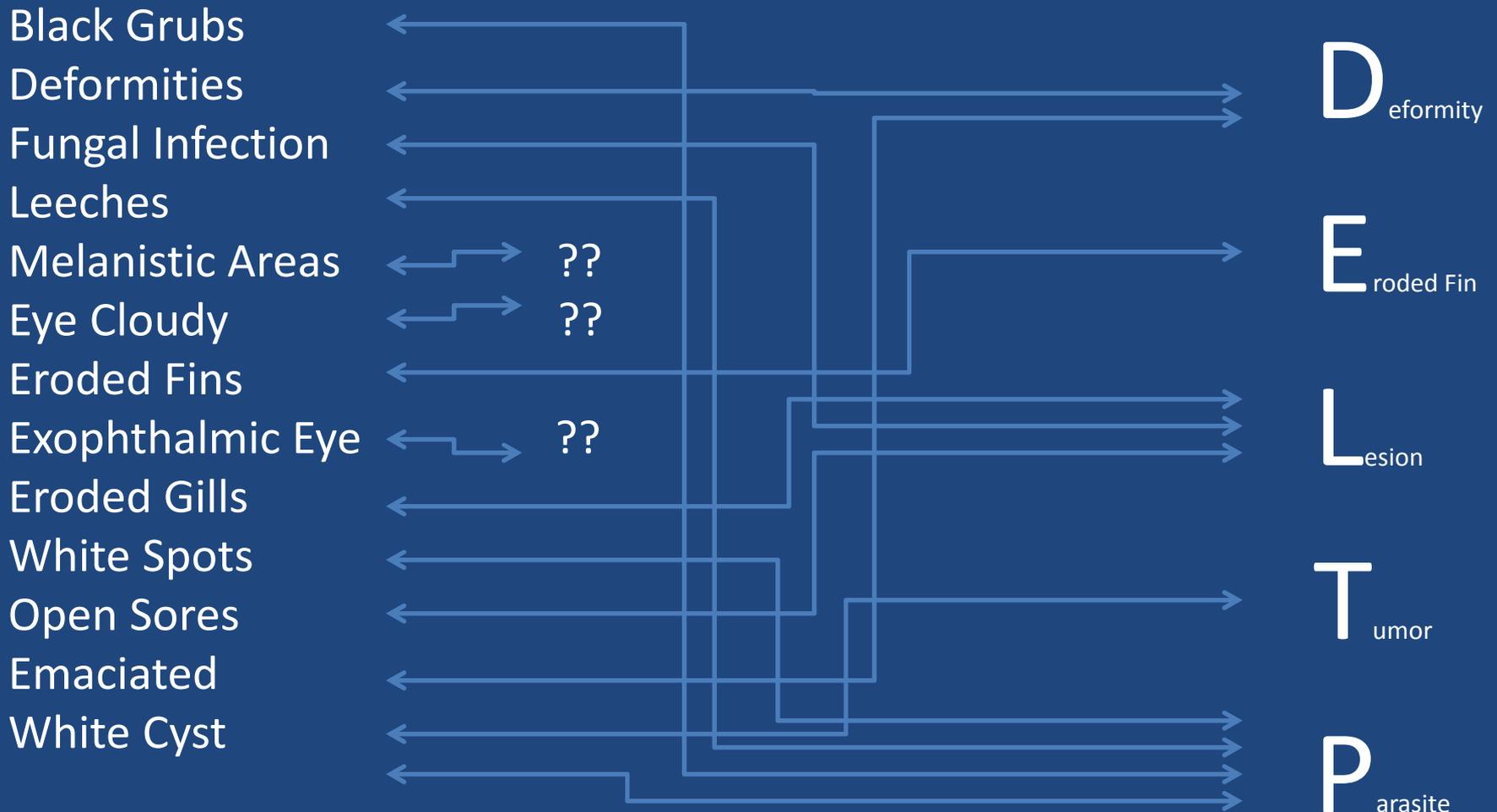


Fungal Infection

Necrotic Tissue

Many-to-One Relationships

(still evolving... but can keep evolving)





**Susquehanna River Monitoring and Assessment YouTube video:
<http://www.youtube.com/watch?v=oYYS7Ok0eag>**

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